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Sweden's Air Power

Strengthening the Western Alliance

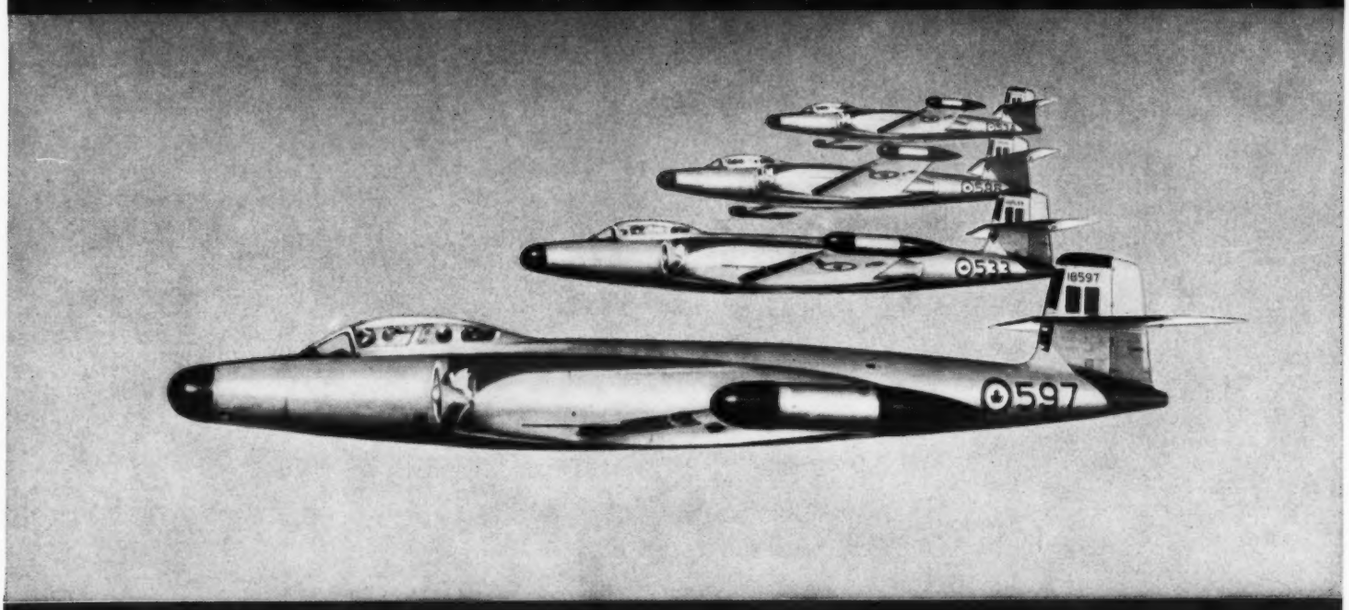
Britain's "V" Bombers

VOLUME XIII

INTERAVIA 1933-1958 SILVER JUBILEE

No 2/1958

FOR SERVICE WITH THE BELGIAN AIR FORCE



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INTERAVIA

Review of World Aviation

Volume XIII **No. 2** **February 1958**

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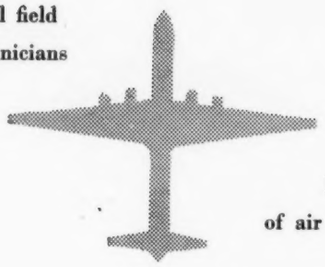

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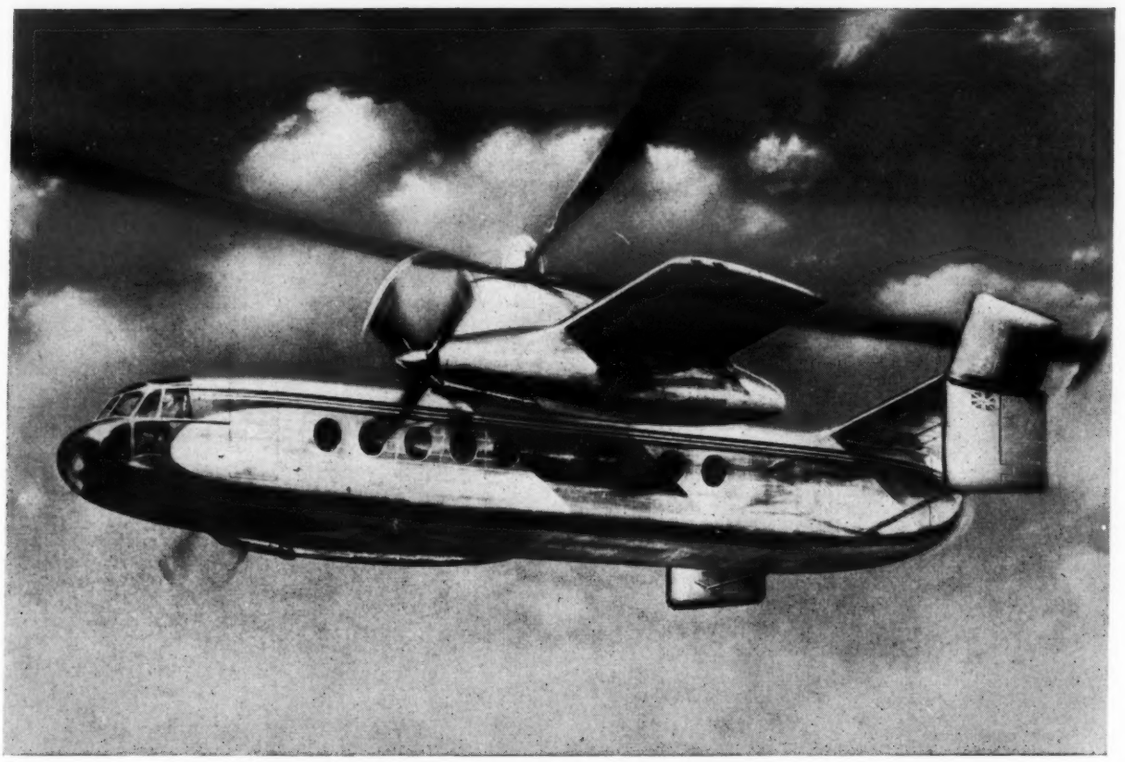

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INTERAVIA

Deadline Notes

No. 2, 1958

● **Professor Ernst Heinkel,** who celebrated his 70th birthday on January 24th, died of a cerebral haemorrhage less than a week later on January 30th. Especially during the past few weeks efforts have been made to re-establish a broader financial and industrial basis for the Heinkel-Werke A.G., Stuttgart ; even though pioneer Ernst Heinkel did not live to see the rebirth of his company's fame, it is certain that his work will be continued and his name will be linked with the history of aviation.

● **Flying Atar and coleopter projects dropped ?** According to a report in the newspaper « Parisien Libéré », SNECMA has decided to discontinue research and development work on the *Flying Atar* and the C-450 coleopters because of lack of funds. The State has so far been contributing less than 45 percent of the cost. SNECMA reportedly has opened talks with a German group which might raise the necessary money to continue the projects.

● **Garuda Indonesian Airways** will have to cut down its operations by 40 to 50 per cent following the cancellation of its contract with K.L.M. Royal Dutch Airlines. Communications Minister Sukardan said in Jakarta that this is a fact which the country has to accept for the moment ; he stated that the Indonesian Government has not yet taken any steps to recruit flying personnel abroad to replace the 300 Dutch experts who had been asked to leave Indonesia. According to an AFP message, a number of business men and publishers have protested to the Government against the reduction in Garuda services, claiming for example that the breakdown in air communications had resulted in a 50 percent drop in newspaper circulations.

● **Air India International** plans to open a direct New Delhi-Budapest air service by the end of this year, and B. R. Patel, Vice-Chairman of the A.I.I. Board, will visit Moscow early in February to discuss the opening of regular services between New Delhi and Moscow. It had already been reported earlier that Soviet officials were seeking permission to operate jet-liner services to New Delhi.

● **Shankar Prasad,** Chairman of Indian Airlines Corporation, has been appointed Director-General of Post and Telegraphs but will retain the Chairmanship of I.A.C. until new arrangements are made by the Government. Reports from Bombay indicate that J. R. D. Tata, now Chairman of Air India International, may become Chairman of both Corporation Boards, or that he may become Chairman of a common Board for both Corporations.

● **Japan Air Lines** has asked the Japanese Government to negotiate with the U.S. authorities to obtain the transfer of certain facilities at Tokyo International Airport now being used by the U.S. Air Force. In making its request J.A.L. pointed out that the recent increase in air traffic demanded that the airport should be reserved exclusively for commercial flying. Unless more space was made available at the airport, J.A.L.'s principal base, the company would not be able to inaugurate trans-Pacific DC-7C services on April 1st as planned.

● **Heavy financial losses** sustained on the domestic network have forced the Polish carrier L.O.T. to suspend all flights on three of its most unprofitable routes. Substantial fare increases on internal routes have resulted in a considerable drop in traffic.

● Air space over certain areas of **western and central Poland** has been declared out-of-bounds to all civil and military aircraft which have not obtained special clearance to fly over the area. Soviet aircraft operating between the Soviet Union and east Germany are restricted to two air corridors.

● **Vickers Viscounts operated by Iraqi Airways** are being equipped with Ekco Airborne Search Radar capable of detecting turbulent cloud formations ahead of the aircraft. The device is manufactured by Ekco Electronics Limited of Southend-on-Sea, Essex.

● A new railway line will provide a **direct link between Orly Airport and the centre of Paris.** The decision to build the new line was made by the Minister for Public Works when it was realized that existing road connections will be inadequate to deal with the expected increase in traffic. It is estimated that the airport will handle some 3,000,000 passengers in 1960, 5,000,000 in 1965 and 10,000,000 in 1970. At the same time the Gare d'Orsay will become the Paris central air terminal. Construction of the Orly-Orsay line is due for completion by the summer of 1961 and will cost approximately 10,000,000,000 French francs.

● **The management of Schiphol Airport, Amsterdam,** was taken over by the recently formed private company Naamloze Vennootschap Luchthaven Schiphol on January 22nd, 1958.

● **An air agreement between Belgium and Morocco** was signed in Rabat on January 21st, 1958. The agreement gives a Belgian operator the right to operate direct services between Brussels and Rabat and on to Leopoldville. The Moroccan flag carrier Royal Air Maroc is authorized to operate direct services to Brussels.

● **A. T. A. opposes fuel tax :** In a statement criticizing the proposed increase in aviation fuel taxes, Stuart G. Tipton, President of the Air Transport Association of America, said that the plan was " unrealistic from an economic standpoint ". Tipton said that the airlines paid approximately $25,000,000 in fuel taxes in 1957 and this compared with an estimated industry-wide profit for the same period of approximately $25,000,000 ; if only the first step in the proposed tax increase had been in effect during 1957, the total cost to the industry would have been $43,000,000 or 72 percent more than the industry's profit for the year. The proposal is to increase the fuel tax from two cents to three-and-a-half cents per gallon, with further increases of three-quarters of a cent each year, eventually reaching six-and-

a-half cents per gallon ; this would cost the airlines the following approximate amounts : 1958 - $49,000,000 ; 1959 - $70,000,000 ; 1960 - $107,000,000; 1961 - $141,000,000; and 1962 - $167,000,000.

● **The British aircraft industry** in 1957 sold more of its products abroad than ever before, according to the figures released by the Society of British Aircraft Constructors. Since the end of the war the industry's exports have totalled more than £650,000,000, of which some £167,000,000 has been accounted for by the sale of aircraft engines. The S.B.A.C. figures for 1957 are : aircraft and parts - £69,767,417 ; engines - £40,642,162 (an increase of one-third over 1956's total £27,902,808) ; tyres - £814,340 (as against £687,821) ; electrical appliances - £3,267,975 (£2,682,209) ; instruments - £1,979,216 (£1,367,419). India headed the list of overseas buyers with almost £11,000,000 worth of aircraft and parts ; the Netherlands was second with just under £6,000,000, followed by Sweden - £5,600,000, the United States - £5,100,000, Canada - £3,900,000, France - £3,100,000 and Israel - £3,000,000.

● **Airborne Bendix-Decca Navigator equipment** for helicopters is to be evaluated in the New York area, the Airways Modernization Board has announced. Arrangements are being made to mount the equipment in New York Airways helicopter fleet, and evaluation operations will commence in about three months time. A.M.B. is contracting with four organizations for services in connection with the programme to determine the best method of helicopter navigation and air traffic control : Pacific Division, Bendix Aviation Corp. will furnish, install and maintain the navigation equipment ; Bell Helicopter Corp. will modify a special A.M.B. test helicopter, installing advanced types of instrumentation developed by Bell and Bendix, and this helicopter will be flown by A.M.B. pilots for special engineering and other test work ; New York Airways will fly the navigational unit on its scheduled flights and report on system performance ; Airborne Instruments Laboratory will provide engineering assistance to A.M.B. during the programme, and will measure the technical performance of the system.

● **The Morane-Saulnier MS-760 Paris executive jet aircraft** will be marketed in the United States and Canada by Beech Aircraft Corporation at a package price of $210,000. This price, $90,000 lower than the quoted 1955 figure, includes the complete aircraft painted and upholstered to customers' specifications in a standard pattern, together with small spares, ground handling equipment, special tools and an MS-760 maintenance training course for one mechanic. Cabin pressurization will be standard equipment.

● **The Hughes Tool Company** has acquired an additional 35,100 shares of Trans World Airlines common stock, increasing its holding to 5,216,501 shares or nearly 78.2 percent of the total.

● **General Lombardi** of the Italian Army, Secretary General of the Defence Ministry (Army), has been appointed to succeed Air Force General Silvio Napoli as Chief of the Minister's Personal Staff ; Brigadier General R. Roveda (Air Force) and Captain E. Henke (Navy) will be his deputies. General Napoli will become Chief of the Air Staff on February 1st.

Workshop Briefs

• The *Fiat G.91A* light strike fighter, an improved version of the G91, has the same Bristol *Orpheus BOr.3* power unit with a thrust of 4,850 lb., but has automatic leading edge slats for improved performance at low speeds, and a slightly increased wing area. The improved version also has two auxiliary wing fuel tanks, each of 39.6 Imp. gals, which give the aircraft an approx. 10 percent increase in its radius of action, now up to 180 n.m. In addition to the improved radius of action the G.91A has improved manœuvrability and a roughly 25 percent reduced take-off distance : on grass runways 1,575 feet without, or 2,000 feet with external loading, compared with 1,970 feet and 2,460 feet for the original version.

• The *Aviamilano F.14 Nibbio* four-seat sports and business aircraft made its first flight on January 17th, at Milan-Linate Airport. The F.14 is powered by a single 180 h.p. Lycoming O-360.

• During recent landing trials the *Lockheed Electra* turboprop transport was brought to a full stop in 900 feet at a weight of 91,500 lb. The *Electra's* maximum landing weight is 95,560 lb.

• Vickers-Armstrongs has announced a new "Local Service" version of the *Viscount* designated Type V.790. The short-haul version *Viscount* will have accommodation for 56 passengers with standard seating, or up to a maximum of 61. Power units 4 Rolls-Royce *Dart 506s* ; cruising speed 278 knots ; gross weight 61,500 lb. ; maximum landing weight 58,500 lb. ; payload 11,660 lb.

• The *Cessna Skylane* is a new sports and touring aircraft, developed from the Cessna 182, and equipped with the Land-O-Matic nose-wheel undercarriage. The *Skylane* is now in production at Cessna Aircraft Co.'s Wichita, Kansas, plant. Price : $16,850.

• An *unmanned surveillance drone* is being developed by the Fairchild Engine and Airplane Corp. The Fairchild drone is reportedly jet-powered, with the air intake below the fuselage ; delta-wing design with slightly swept-back rudder unit and no tailplane.

• Development of *a new helicopter by Saunders-Roe Ltd.*, possibly turbine-powered, has been mentioned for the first time.

• Development of a *new solid-propellant ballistic missile,* which will eventually succeed the *Redstone* liquid-propellant missile, has been authorized for the U.S. Army on a super-priority basis. Recent advances in solid propellant technology, resulting largely from the U.S. Army's *Sergeant* and the U.S. Navy's *Polaris* programmes, have made it possible to start the development of this programme without delay. As yet unnamed, the new missile will be smaller, lighter and therefore more mobile than the *Redstone*.

• The *Westinghouse J54-WE-2* jet engine, with a thrust of 6,500 lb., has recently completed a first 150-hour test bed run ; flight testing of this lightweight power unit is also known to have commenced recently. The J54, in production for the *Titan,* has a one-piece 16-stage axial compressor, with a compression ratio of 9 : 1 ; air mass flow 100 lb./sec. ; annular combustion chamber ; two-stage turbine ; length, with jet pipe, approx. 158 ins. ; diameter 35 ins. ; weight 1,400 lb.

• The *Boeing B-52G,* latest version of the B-52 *Stratofortress,* will go into production in 1958. Compared with earlier versions the B-52G will have considerably increased range.

• Additional data on the Argentine Fábrica Militar de Aviones Córdoba *I.A.45 communications aircraft* have become available since the section "What's in the Air ?" went to press. Span 44 ft. 6 5/8 ins. ; length 29 ft. 4 ins. ; wing area 204.5 sq.ft. ; gross weight 3,590 lb. ; cruising speed 140 knots ; landing speed 51 knots with a landing run of 820 ft. ; take-off distance to clear 50 ft. obstruction 1,476 ft. at sea level ; service ceiling 20,340 ft., or 6,560 ft. on one engine with full load. The I.A.45 is an all-metal shoulder-wing monoplane equipped with two 150 h.p. Lycoming engines and Hartzell pusher propellers. Normal cabin layout is for pilot and four passengers. Hydraulically retractable nose-wheel undercarriage.

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The British Air Registration Board have already confirmed that a civil version of the same engine has successfully completed a 150 hour test run in accordance with the combined U.S./U.K. Civil Type Test Schedule at a dry take-off rating of 16,500 lb. thrust.

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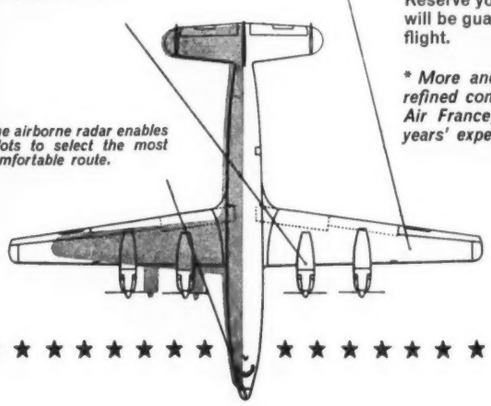

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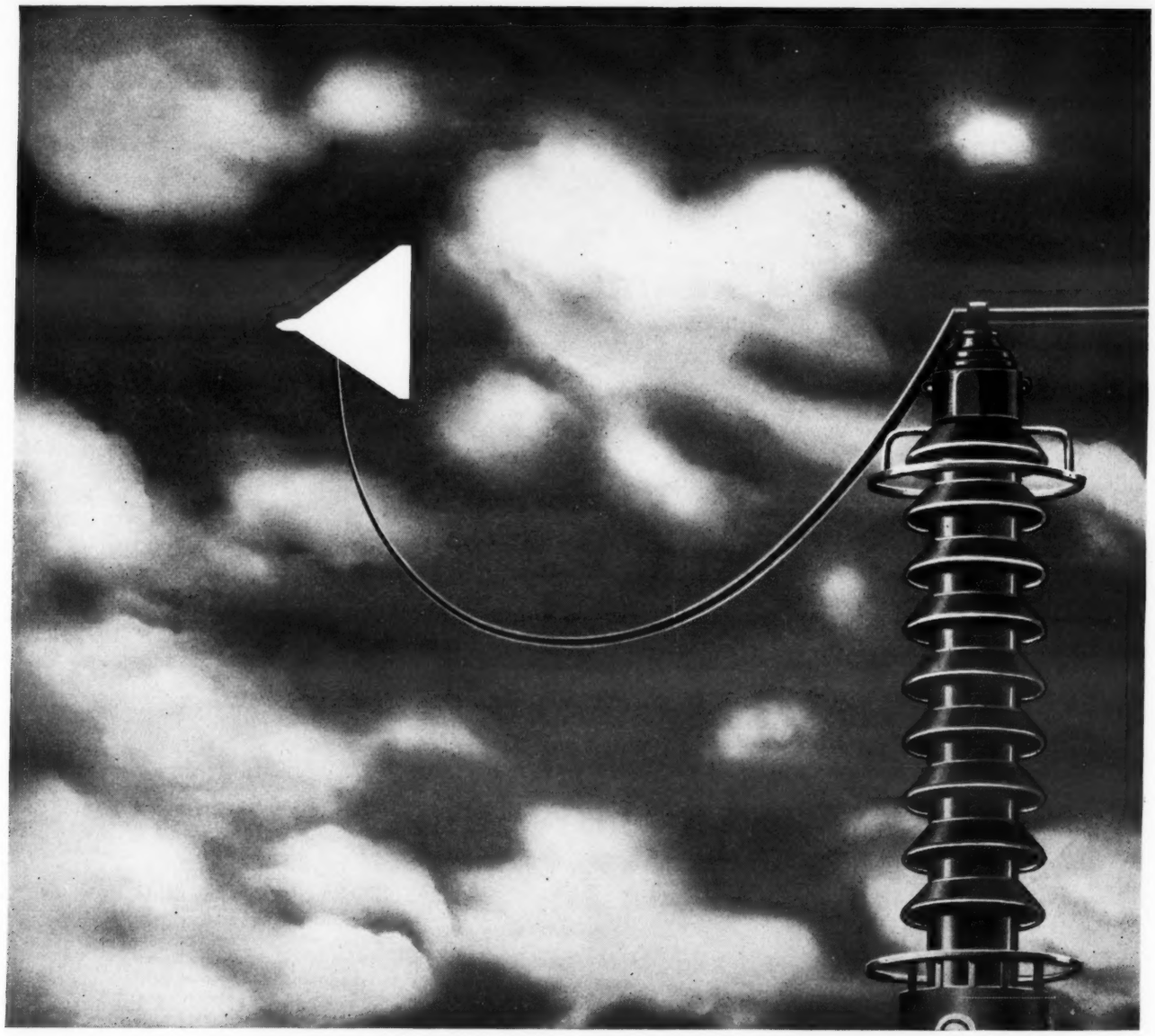


Airborne Power Station

The era is fast disappearing when the aeroplane's requirements for electrical power were little different from those of motor vehicles and the need was satisfied by D.C. generators and accumulators.

We agree that D.C. still has its use in the air for aircraft with limited power requirements but in the majority of large modern aircraft, where almost every moving part is operated or assisted by electrical power, the supply required is nearer the scale produced by a subsidiary power station. As with all generating stations, experience has proved that electrical power is provided more efficiently, economically and reliably in the form of constant frequency A.C. It is therefore fitting that ENGLISH ELECTRIC, who have designed and built so many of this country's—and the world's—major power stations, should be in the forefront of this revolution in technique. By undertaking the manufacture under licence of the well-proven Sundstrand Constant-speed Alternator Drive, and by developing simultaneously an expanded range of alternators, switch-gear, transformers and A.C. motors to aviation requirements, ENGLISH ELECTRIC have put themselves in a position to meet tomorrow's needs—however big—for the airborne power station.

'ENGLISH ELECTRIC'
aircraft equipment

THE **ENGLISH ELECTRIC** COMPANY LIMITED · AIRCRAFT EQUIPMENT DIVISION · PHOENIX WORKS · BRADFORD

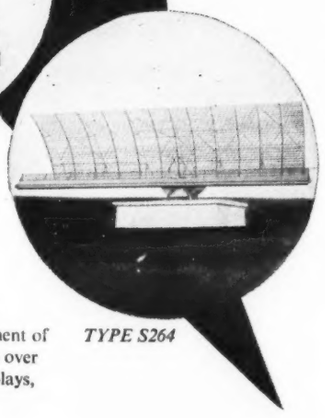
AE.28

A MEMBER OF THE **ENGLISH ELECTRIC** AVIATION GROUP

Marconi's hand in Airport Radar

Planning and Installation of Military and Civil Radar Systems

TYPE SNW 51



TYPE S264

TYPE SNW 51 3 cm STORM WARNING RADAR

Storm Warning Radar can now be recognised as an important element of an Airport Radar system.
The SNW 51 provides an accurate and up-to-the-moment picture of the movement of storm centres and areas of precipitation over ranges up to 200 n. miles. Remote displays, static or mobile versions are available.

TYPE S 264 AIRFIELD CONTROL RADAR

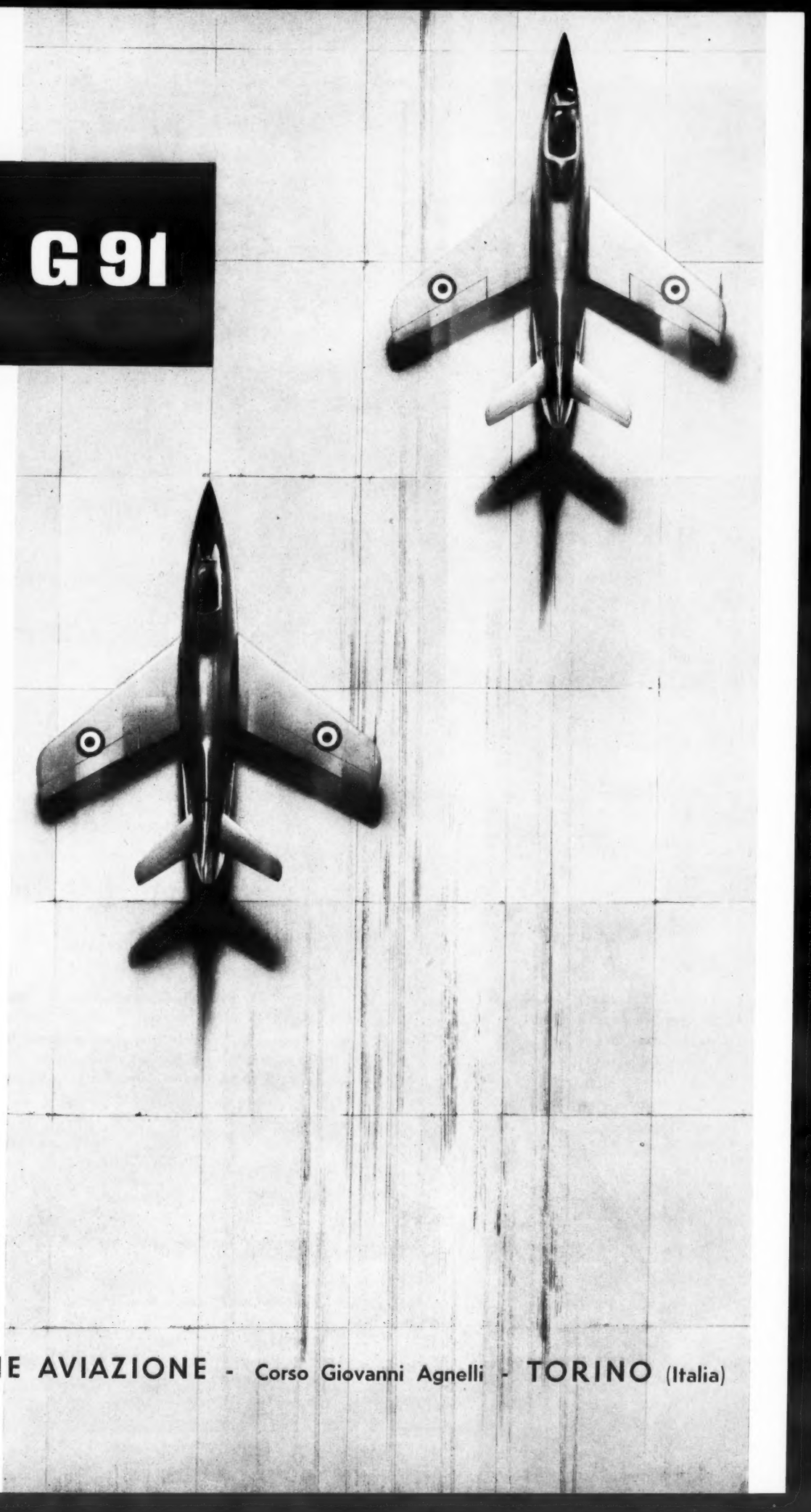
has been specifically designed for civil air traffic control and is not a modified military type. It operates at full efficiency in all weathers because the wavelength is long enough to penetrate cloud. Ground clutter which obscures aircraft response is removed by means of an extremely effective M.T.I., thus rendering identification procedure unnecessary. The equipment is instantly operational at its rated performance because it is crystal controlled and needs no adjustment after switching on. The S 264 is suitable for monitoring aircraft on airways at the approach to the control zone, controlling them in the stacks and feeding them on to ILS or PAR, providing limited P.P.I. controlled approach to runways and taking control of outbound aircraft as soon as they are airborne.

MARCONI

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND
R3

FIAT G 91

Bristol Orpheus engine

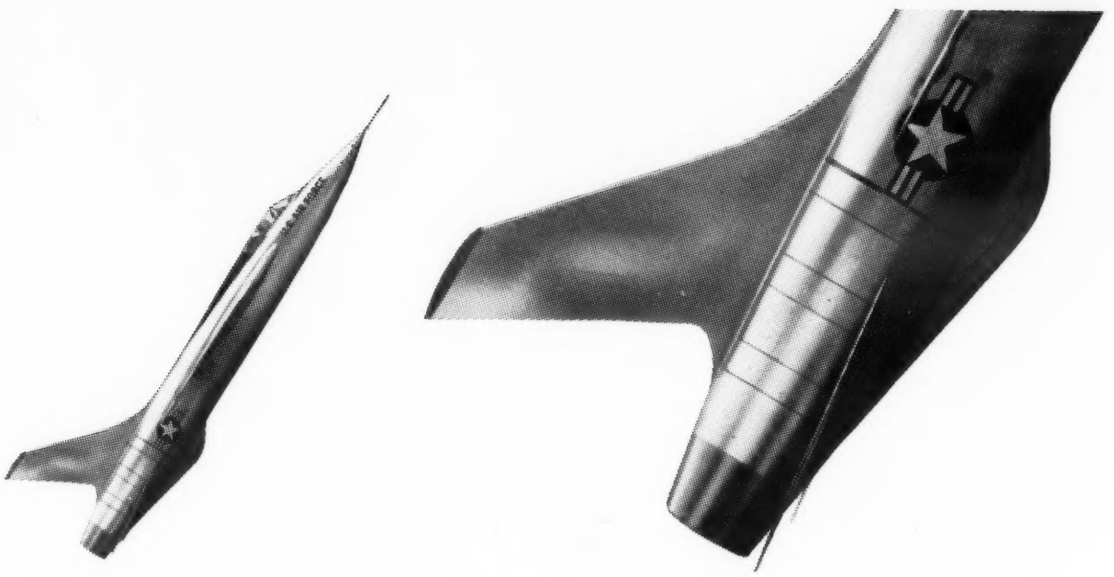


FIAT G 91

Light tactical support fighter for N.A.T.O., which proved its qualities in the technical trials at Brétigny, France.

Main features of this aircraft: capability to operate on semi-prepared fields or grass runways, short take-off and landing distances, high manœuvrability, small dimensions, light weight, low initial and operating costs.

FIAT - DIREZIONE AVIAZIONE - Corso Giovanni Agnelli - TORINO (Italia)



NOW YOU SEE IT · · NOW YOU DON'T

THE F-105

Furious speed . . . smashing primal power . . . overwhelming persuader for peace, this new Thundercraft, more than any other . . . is designed to deliver Tactical Air Command's composite air strikeforce knockout punch at any target, any time!*

Latest in the line . . . The* **THUNDERCHIEF

REPUBLIC AVIATION

FARMINGDALE, LONG ISLAND, N. Y.

Designers and Builders of the Incomparable **THUNDER-CRAFT**

Short haul champion, the Fokker F.27 FRIENDSHIP, provides complete breathing comfort during its quick climbs and at all flight levels

Demand for the Fokker F.27 has been strong because of the aircraft's superior ability to operate from short runways and its high payload, low block time and economical operation. Among the major airlines which have already placed orders are Aer Lingus Teoranta, Trans-Australia Airlines, K.L.M., Braathens and Philippine Airlines.

AiResearch products make an important contribution to the performance of this fine twin-turboprop transport. They include air conditioning, pressurization and temperature control systems, heat transfer equipment, stall warning transducers and air valves.

All over the world the equipment developed by AiResearch Manufacturing Divisions aids in the establishment of new aircraft standards. You are invited to write for specific information and for the addresses of our licensees and representatives in Europe, the United Kingdom and Japan.

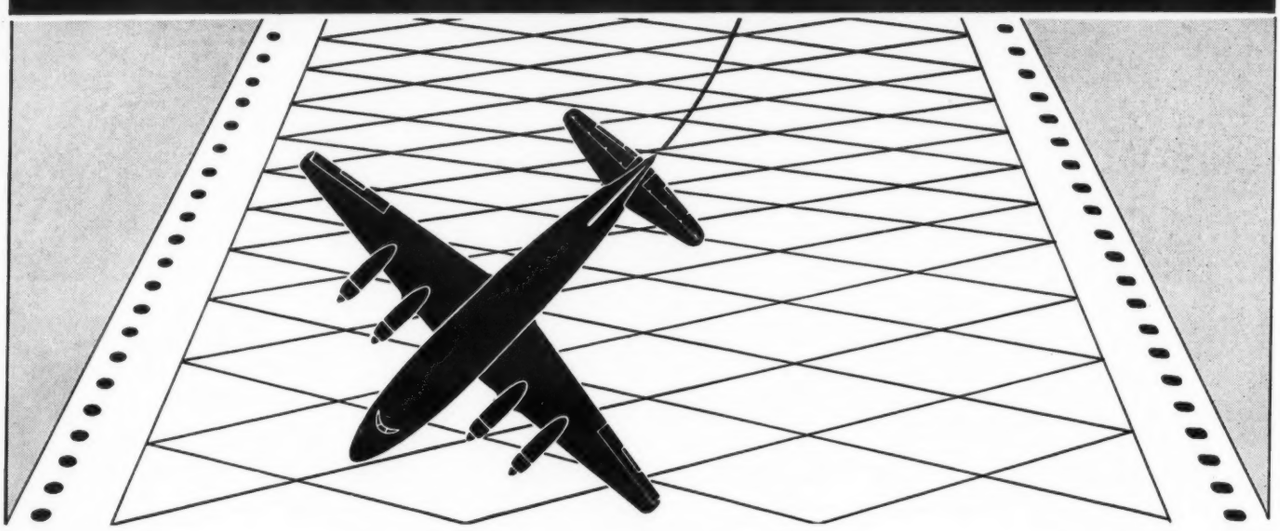
THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California ... Phoenix, Arizona • U.S.A.

Designers and manufacturers of aircraft and missile systems and components: REFRIGERATION SYSTEMS • PNEUMATIC VALVES AND CONTROLS • TEMPERATURE CONTROLS
CABIN AIR COMPRESSORS • TURBINE MOTORS • GAS TURBINE ENGINES • CABIN PRESSURE CONTROLS • HEAT TRANSFER EQUIPMENT • ELECTRO-MECHANICAL EQUIPMENT • ELECTRONIC COMPUTERS AND CONTROLS

Situation under control



The Decca Navigator System is fast becoming an integral part of the entire field of aviation. The task of the Air Traffic Controller in particular is made easier when Decca fitted aircraft fly accurately on pre-determined tracks, their pilots carrying out instructions readily and precisely. For the first time he can integrate aircraft of all types—fixed wing or rotary, turbo-prop or jet, into a single air traffic control plan based on one ground navigation aid. Decca fitted aircraft navigating accurately allow separation standards to be reduced and enable him to make the greatest use of the limited controlled air space. He can do so because Decca is the only system accurate enough to ensure that aircraft can fly on track, on schedule, at all altitudes, in all weathers, over every kind of terrain. Decca tracks and reporting points have been established in the London F. I.R. since July 1956, and have also been introduced at Frankfurt. Now that Dectra, the long range navaid for the North Atlantic, is on the air, the day when all the air routes of the world will be Decca flown comes nearer. Then indeed the situation will be under control.

THE DECCA NAVIGATOR

THE WORLD'S MOST ACCURATE NAVIGATION SYSTEM

THE DECCA NAVIGATOR COMPANY LIMITED LONDON

U.S. Air Transportation and Aircraft Industry in mid-January 1958

BY SCOTT HERSHEY, NEW YORK

Investors this time of the year are trying to gauge the future on the basis of what has happened in the past. Almost everybody in and around Wall Street has some idea of what happened in 1957, and many have an idea of why. Only the experts, though, think they know what will happen in 1958. Almost anyone will be confused if he reads too much with rose-colored glasses. Most opinion is agreed that the economic situation will not adjust itself before mid-year. A lot will depend on what happens in Washington and abroad. What Congress does on the question of defense spending and on taxes will have a marked effect on the nation's economy and consequently on the market. A big help toward the smoothing out of irregularities would be less tension abroad.

A reflection of confidence was seen in the market rally shortly after the first of the year which added some $5 billion to the value of shares listed on the New York Stock Exchange.

Aviation securities which had rough sledding for the most part in 1957's volatile but sensitive market were not involved in this rally except in spots, and most aviation stocks will have to perform in a spectacular manner to turn the minus signs with which they ended the year into anywhere near their prices of two years ago.

The men who handle the money in the airline front offices these days are handling a lot of it, but the trouble is they are writing their records largely in red ink between the time the money comes in across the counters and is finally paid out in operating costs.

This situation is reflected in their securities and despite the fact, or perhaps because of the fact, that we are on the threshold of the jet age, there is no great crush of buyers around the trading posts on the floor of the New York Stock Exchange where airline securities change hands.

At the same time, immediate problems in the airline industry which include greater competition, increasing costs and the resultant squeeze on profits, do not deter leading airline analysts from forecasting a dynamic growth for the industry over the long term.

Meanwhile there are some figures which have now come to light and which investors may want to consider in the immediate months ahead.

In 36 stock groups, there were only four which closed higher than in the preceding year. There were ten industry groups which were down less than 15 percent. There were ten groups which were off 15 to 30 percent. And there were twelve industry groups which were down more than 30 percent. In this group were the aircraft manufacturers and the airlines.

Their unhappy story so far as shareholders are concerned looked something like this : In 1955 aircraft manufacturing stocks were up 43.1 percent. In 1956 aircraft manufacturing stocks were up 19.4 percent. In 1957 aircraft manufacturing stocks were down 32.9 percent. These figures speak for themselves in a strong voice.

But listen to the airline figures. In 1955 airline stocks were down a mere 3.3 percent. In 1956 they were off 10.9 percent. And in the year just closed they showed a minus 46.1 percent.

The refusal of the Civil Aeronautics Board to grant emergency fare increases for the airlines put in jeopardy the switch to the jet age. And the Defense Department's stretch-out of its aircraft and missile contracts, plus outright cancellations, all but demoralized this vital industry.

A look at the price changes in a few representative aviation stocks plainly shows how they fared in this market, the third year since the bull market got under way.

American Airlines, for example, last year showed a high of $28\frac{1}{4}$, a low of 14, closed at $14\frac{1}{8}$, a change of minus $9\frac{1}{4}$. Boeing hit a high of $61\frac{1}{8}$, a low of 29 and closed at $37\frac{7}{8}$, a change of minus $25\frac{3}{8}$. Douglas hit a high of 91, a low of $50\frac{5}{8}$ and closed at $70\frac{1}{8}$, a change of minus $18\frac{5}{8}$.

Eastern's high was $51\frac{3}{4}$, the low 27 and closed at $29\frac{1}{8}$, a change of minus $20\frac{5}{8}$. North American Aviation had a high of $39\frac{1}{4}$, a low of $20\frac{1}{8}$ and closed at $30\frac{1}{4}$ for a change of minus $8\frac{3}{4}$. Northrop had a high of $28\frac{1}{8}$, a low of $15\frac{3}{4}$ and closed at 22 for a change of minus $2\frac{3}{8}$. Pan American hit a high of $18\frac{1}{8}$, a low of $12\frac{1}{8}$ and closed at $12\frac{3}{4}$, a change of minus 6. United Aircraft had a high of $75\frac{1}{4}$, a low of 48 and closed at $52\frac{3}{4}$, a change of minus 22.

Even the most minute examination fails to disclose a plus sign anywhere in the prices of these stocks, all representing sound companies, all soundly managed and all with a sound future.

The aircraft industry, deeply involved in missile programs, is somewhat reserved about its future in a year of certain increased spending for the new weapons. The projected spending in missiles represents a sizeable increase in comparison with the previous year's outlay for these weapons. At the same time, the increase is far from monumental when measured against the over-all defense budget of probably around $40,000,000,000 for the fiscal year of 1958. Pentagon estimates are it may spend between $2,500,000,000 and $2,900,000,000 exclusively for missiles in 1958. Hence the reservations of the aircraft industry in looking at the overall spending picture.

But it will take more than this to bolster aircraft securities, and at this point they need bolstering. At the same time such companies as Boeing and United Aircraft are looking for 1958 sales to be near 1957 sales with the profit margin up.

The same thing cannot be said for the airlines, which are existing in a state of " profitless prosperity ". This contradictory phrase points up the two principal and oft-stated problems of the carriers—the need for a rate structure raised sufficiently to ensure that the growing volume of business, both freight and passenger, will yield a corresponding rise in net income and better credit standing to meet future needs, and the second the continuing problem of financing by whatever means possible the unaccounted portion of more than $2,800,000,000 in new equipment now on order.

The big story with respect to domestic and foreign makers of aircraft for the airline is of course the gradual dawning of the jet age in commercial aviation. It is overshadowed to some extent by the size of the defense backlogs in the fields of jet fighters, bombers, transports and the growing missile business.

Buoyancy of the market at the beginning of the year doubtless was somewhat inspired by the end of tax loss selling. That, of course, is a technical consideration. But around Wall Street was a more fundamental force that the investing public expects business to become better, and in any general improvement aviation securities are bound to participate in the benefits even though their role may not be as spectacular as some other listings.

INTERNATIONAL MEETINGS AND CONFERENCES

February 11th : IATA - Traffic Conference 3 Agency Committee. Singapore.

February 13th-15th : Spring Meeting of the National Society of Professional Engineers. Michigan.

February 21st : Meteorological Congress. New Delhi.

February 24th : IATA - Simplification Working Group. Paris.

February 24th-March 11th : ICAO/WMO - Telecommunications meetings. Geneva.

February 26th-27th : AFA - 3rd Annual Jet Age Conference Air Force Association. Washington.

February 27th-March 22nd : Australian Industries Fair. Melbourne.

March : International Fair. Plovdiv, Bulgaria.

March 1st : British Interplanetary Society - " The Guidance and Control of Long-range Vehicles " by Professor G. A. Witfield. London.

March 2nd-6th : ASME - International Gas Turbine Division Conference and Exhibition. Washington.

March 2nd-11th : Leipzig Spring Fair.

March 4th : IATA - North Atlantic Commodity Rate Board. New York.

March 5th : IATA - North Atlantic Regional Technical Panel. Montreal.

March 7th : British Helicopter Association - " Some Ways of Obtaining an Integrated Aircraft " by Dr. D. Küchemann. Royal Aircraft Establishment, London.

March 9th-11th : Vienna Spring Fair.

March 11th : IATA - Composite Agency Committee. Paris.

March 13th-14th : 2nd National Conference on Aviation Education. Washington.

March 14th-23rd : Finland Industries Fair. Helsinki.

March 17th-20th : ARS/ASME - Joint Aviation Conference. Dallas, Texas.

March 18th : IATA - Medical Committee. Washington.

March 18th-19th : Conference on Extremely High Temperatures. AF Cambridge Research Center, Bedford, Massachusetts.

March 18th-19th : First Interservice and Industry Symposium on Guided Missile Training.

March 21st-30th : 12th International Engineering Fair. Copenhagen.

March 23rd-29th : Esso International Congress. Baden-Baden.

March 24th : IATA - Air/Sea Working Group. Paris.

March 24th-27th : IRE - National Convention and Radio Engineering Show. New York.

March 24th-29th : 4th International Instrument Show. London.

April 1st-3rd : ASME - Division of Instruments and Regulators Conference. University of Delaware. Newark, Delaware.

April 5th : British Interplanetary Society - " Problems of Handling Large Missiles " by F. R. F. Taylor. London.

April 9th : ICAO - Rules of the Air, Air Traffic Services and Search and Rescue Division. Montreal.

McElroy Renders His Account

" Since the Korean armistice," President Eisenhower stated in his State of the Union Message on January 9th, 1958, " the American people have spent $225 billion in maintaining and strengthening this overall defensive shield "... Four days later in the Budget Message for the 1958-59 fiscal year, the President asked for a further $47.1 billion for national security, foreign military aid, etc. This is no less than 64% of the total Governmental Budget estimates (73.9 billion). Obviously the authorities have no easy task before them in explaining to the American taxpayer why 64 cents of each Budget dollar go towards defence and only 22 cents towards national civil benefits (14 cents are intended for interest and other payments). Their task is made even more difficult by the fact that security regulations forbid them to reveal details.

Secretary of Defense Neil McElroy gave a general survey of the defence programme and the principles lying behind it, when on January 13th, 1958, he made his first appearance before the Committee on Armed Services of the House of Representatives. The following are short extracts from his statement :

" ... So while we are maintaining our ability to meet the war of today, we must at the same time be pushing rapidly forward in the development and procurement of new advanced weapons which may not be operational for two, three or even as many as ten years. This increases the burden on all of us...

... the costs go up enormously. A World War II submarine cost $4.7 million. In 1958 a submarine, now nuclear powered, costs ten times as much, or $47 million. The cost of an aircraft carrier has gone up more than three times since World War II — from $55 million to $195 million, and nuclear power will add another hundred million to that cost. The heavy bomber of World War II, the B-29, cost $600,000 ; today's B-52 costs some $7 million. And similar increases have occurred in the fighter bombers, destroyers, and other major items of military expense...

... This is a large program and an expensive one ... but our nation has the strength and capacities required, and we face our task with confidence...

... I should now like to give you a brief résumé of our military posture expressed in terms of the forces of the Army, Navy, Air Force and Marine Corps in the year ahead...

... The greatly increased firepower of modern weapons and the continuing increase in efficiency permit a further reduction in the number of military personnel. Of 2,525,000 officers and men in the active establishment, the Army will have 870,000 ; Navy 630,000 ; Air Force, 850,000 ; and Marine Corps, 175,000. The strength of 2,525,000 compares with a strength of just over 2.6 million, planned for the end of Fiscal '58. In addition to the active forces, there will be nearly a million reservists of all Services in paid status...

... the Army will be organized around 14 divisions, which will have been reorganized as " Pentomic " divisions with organic nuclear firepower. Including those units in divisions, the Army will have 43 surface-to-surface missile battalions and 73 surface-to-air missile battalions...

... The Navy will have 864 active ships ... Included within this total are 14 attack carriers.

... The Air Force will have 105 wings, 43 of which are strategic ; 27, air defense ; and 35 tactical. Within the tactical totals is one *Matador* guided missile wing. The Air Force will also have in process of activation several intercontinental and intermediate range missile units during Fiscal '59. These include *Snark, Atlas, Thor,* and *Jupiter* types... The Air Force will also have activated its first *Bomarc* surface-to-air missile unit.

It is important to observe that the strength of our strategic air forces is being improved by continued conversion to the B-52 jet bomber, by production of the first operational aircraft of the supersonic B-58, by a new nuclear air-to-surface missile, by advanced airborne electronic equipment, by greater dispersal of bases, and by a greatly improved " alert " ability to react. In the air defense field, we shall enjoy the benefits of improved air-to-air missiles, including the MB-1 atomic rocket...

... The Intermediate Range Ballistic Missile and the Intercontinental Ballistic Missile fall into the category of those which are in the later stages of development, but not yet operational. This is a critical area. We do not have positive evidence that Russia is ahead of us in these long-range missiles, but the only basis on which we can properly operate is to assume that they are. We are going ahead, as you know, with production of both the *Jupiter* and the *Thor* in the IRBM field. We should have preferred to wait until one or the other had successfully completed its tests and fully proved itself, and then go ahead with that one. We would have saved some money by doing so. But time is critical in this program. Since we have high hopes that both will prove to be satisfactory, we decided to avail ourselves of the existing production facilities behind both of them, and thus push forward the date on which we could have the IRBM deployable in larger quantities.

We are somewhat farther from an operational ICBM. This program is advancing with the highest priority... However, we believe it vital that we have both systems available to us at the earliest possible moment, ... we have started the construction of two ICBM bases and have made provision for a third in our FY '59 budget."

Photo credits : Front cover : Air Ministry, London ; p. 115 : Interavia ; p. 116 : Royal Swedish Air Force (2), ATP (1) ; pp. 117-119 : author (1), Royal Swedish Air Force (3), manufacturers (2), Interavia files (2) ; p. 120 : manufacturers ; pp. 121-125 : manufacturers ; pp. 126-130 : U.S.A.F. (1), U.S. Army (1), manufacturers (3), Interavia maps (2) ; pp. 131-132 : manufactuerers (1), Interavia drawings (2) ; pp. 139-142 : Air Ministry, London ; p. 143 : manufacturers ; pp. 144-145 : F. Dengremont, Paris (1), Secretariat of State for Air, Paris (2) ; p. 145 : manufacturers ; pp. 146-147 : manufacturers ; pp. 148-149 : U.S. Navy (2), manufacturers (4) ; pp. 150-151 : U.S.A.F. (3), U.S. Army (1), manufacturers (5) ; pp. 152-154 : Sabena (1), Fotokhronika Tass (1), manufacturers (10), Interavia files (2) ; p. 159 : manufacturers ; pp. 160-161 : manufacturers.

Boosted off the launcher by rockets, Bloodhound is within seconds seeking its target at well over 1,000 mph

BLOODHOUND ENTRUSTED WITH MAJOR ROLE IN BRITAIN'S AIR DEFENCE

Bristol/Ferranti Bloodhound complete surface-to-air missile system tested, proved and in full production.

The widespread redeployment of Britain's armed forces, away from manned and towards unmanned weapons, is reflected in Bristol's production lines. Production of the Bloodhound guided weapon system is—with the exception of the Britannia airliner—the largest single activity of the Bristol Group of Companies.

The Bloodhound will become the mainstay of the United Kingdom defence network as surface-to-air missiles progressively take over from the manned fighter. Bloodhounds and their Bristol Thor-type ramjet engines have reached an extremely high stage of development. The system has already proved its effectiveness and is in production for the Royal Air Force.

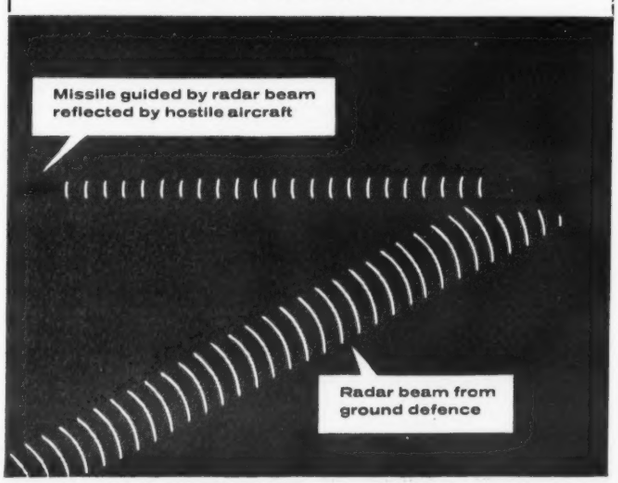
BRISTOL
Bloodhound

BRISTOL AIRCRAFT LIMITED

OPERATION : Bloodhound, with its Ferranti-designed guidance and control system, is a semi-active homing missile; this means that it is guided by a radar beam projected at the target and reflected back to receiving equipment in the missile itself.

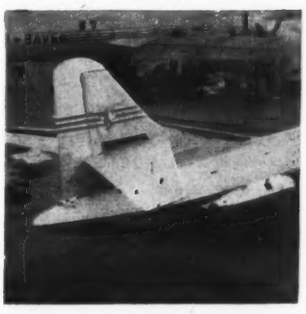
As a hostile aircraft approaches, its position is plotted and followed by radars. Co-ordinates of this position are fed to the missile launchers which move automatically to bear on the target. As soon as the echo from the target indicates, by its strength, that the target is within range, a light flashes in front of the launch controller, who has only to press the firing button to send Bloodhound roaring into the sky.

ELECTRONIC GUIDANCE AND CONTROL BY FERRANTI LTD.



In preparation for the CARAVELLE's entry into service on the scheduled air routes of two continents, SUD-AVIATION is building up a world-wide maintenance and after-sales organization.

FOR THE MOST ECONOMICAL JET AIRLINER ...

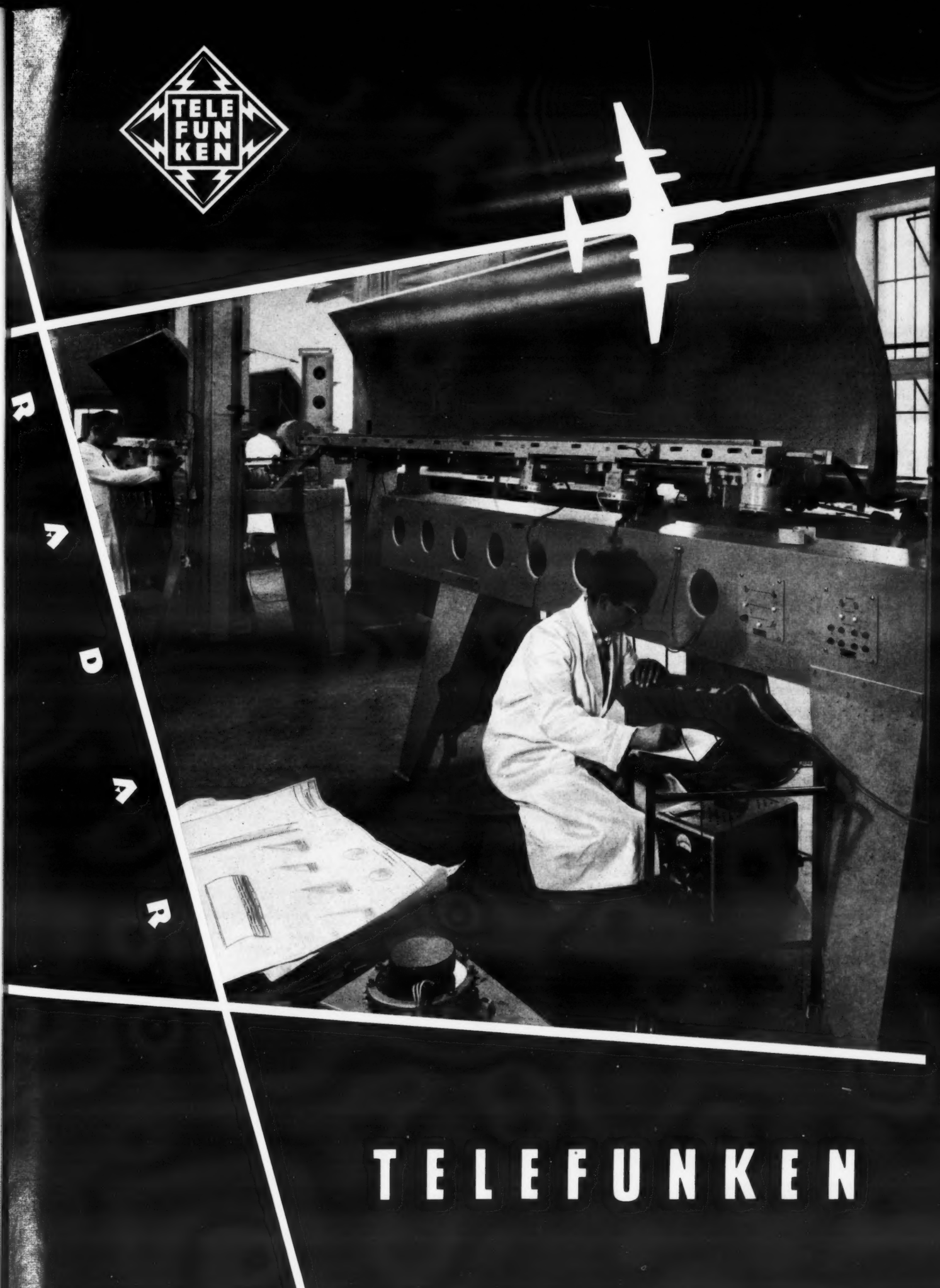


... AN EFFICIENT AFTER-SALES SERVICE.

SUD AVIATION

SOCIÉTÉ NATIONALE DE CONSTRUCTIONS AÉRONAUTIQUES

PARIS - 37, BOULEVARD DE MONTMORENCY


TELE
FUN
KEN
RADAR
TELEFUNKEN

BEFAB Safeland
arresting nets in action

A Republic F 84 G Thunderjet dashing into the BEFAB Safeland arresting net at a speed of 100 miles per hour.

At Rygge Military Airport in Norway Lieutenant Holter-Sörensen went through some exciting seconds when his Thunderjet dashed towards a BEFAB Safeland arresting net at the speed of 100 mph. The aircraft's weight was 16 000 lbs and the braking distance about 280 feet. No damage was caused either to the aircraft or to the arresting gear.
The Safeland arresting nets, which are Swedish patented and designed by the Royal Swedish Air Board, are put up at the ends of the airport runways. The standard length of a net is 180 feet and in this case the height was about 8 feet.

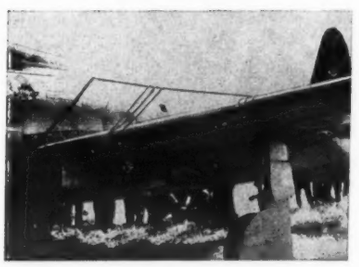
The BEFAB Safeland arresting nets are presently manufactured for all types of aircraft up to 65 000 lbs gross weight at engaging speeds up to 165 mph.

Modern Swedish emergency arresting equipment incorporating the following capabilities :

1. Stabilizes aircraft entering webbing asymmetrically, e.g. when skidding or ground-looping.
2. Causes little or no damage to the aircraft.
3. Simple rigging.
4. Easy to handle and to move from place to place.
5. No extra force on nosewheel.
6. Very low installation costs.
7. Total weight of the equipment about 5000 lbs.

After extensive testing the Safeland arresting nets have already been ordered by several governments — e.g. Denmark, France, Italy, Norway, Sweden, Switzerland, R.A.F., Great Britain and Finland.

Pilot leaving the plane after the successful arresting.



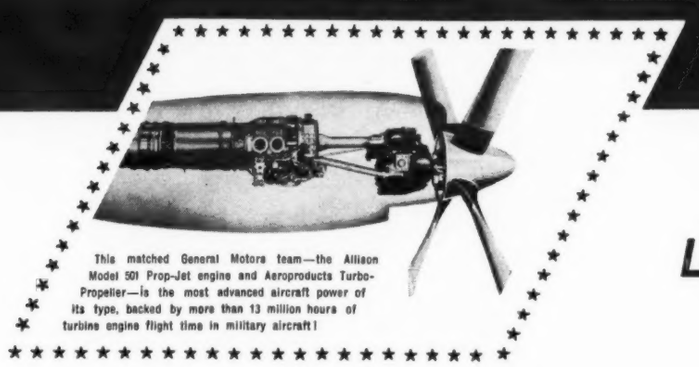
This picture shows how well and carefully the net has engaged the plane.

Exclusively manufactured by

BEFAB BORGS FABRIKS AB
NORRKÖPING - SWEDEN

Designer: Royal Swedish Air Board

The Transport the Airlines Requested:



This matched General Motors team—the Allison Model 501 Prop-Jet engine and Aeroproducts Turbo-Propeller—is the most advanced aircraft power of its type, backed by more than 13 million hours of turbine engine flight time in military aircraft!

the

LOCKHEED ELECTRA

with

ALLISON PROP-JET POWER

ELECTRA UNDERWAY ON FLIGHT PROGRAM. Continuing ahead of schedule in all phases of production and flight, the new Lockheed Electra is already logging flight hours prior to official commencement of CAA certification tests. Powered by four Allison 501 Prop-Jet Engines and Aeroproducts 606 Turbo-Propellers—CAA approved several months ago—this luxurious new passenger transport is America's jet-age answer to medium- and short-distance airline routes. Scheduled to enter commercial service late this year, the Prop-Jet Electra will bring jet-age comfort at cruising speeds of more than 400 miles per hour to air travelers everywhere—will bring new operating economy to the airlines of the world.

144 Lockheed Electras have been purchased by eleven of the world's leading airlines: Aeronaves de Mexico, American, Australian National Airways, Braniff International, Cathay Pacific, Eastern, Garuda, KLM Royal Dutch, National, Pacific Southwest and Western.

ALLISON PROP-JET POWER

... backed by the worlwide resources of

GM
GENERAL MOTORS

Quicker, Simpler

(and that means CHEAPER)

maintenance with the ELAND

EFFICIENT AIRLINES are thinking more and more in terms of propeller turbine propulsion for short and medium haul services. In this field the Napier Eland has a number of outstanding advantages, among them being its extremely low maintenance costs.

CHEAPER ON THE GROUND

The Eland engine consists of four main sub-assemblies: reduction gear, compressor, combustion chambers and turbine. Each sub-assembly is a self-contained unit that can be removed and tested separately. This type of construction makes for easier and quicker maintenance and gets the maximum working life from each component.

CHEAPER IN THE AIR

The Eland is designed for economy. A Convair with piston engines will carry a full payload 250 miles, but the same aircraft, after conversion to Eland engines, is able to extend its range to 970 miles and increase its speed by 55 m.p.h. The extra 2,000 h.p. that is developed by the Elands enables the same aircraft to carry its full payload under operating conditions of extreme temperatures and altitudes. This economy and flexibility can be expressed in substantially lower operating costs.

PASSENGER APPEAL

Passengers need no technical knowledge of aircraft to form stubborn preferences. Once they have experienced (or been told about) the smoothness and quietness of turbo prop flight, they will avoid travelling by piston engined aircraft whenever possible. In addition, the greater simplicity and reliability of the turbo prop engine are factors that weigh heavily with the passenger and influence his choice of airline.

TO BUY OR CONVERT?

While the final decision depends on a number of variables—such as the life of the aircraft, its book value and its revenue earning power—it is almost always sounder economics to convert an existing piston engined machine than to buy a new airliner. An Eland conversion can be carried out for less than a third of the cost of a new aircraft with the certainty that this expenditure will be quickly recovered by the increased earning power.

the era of the ELAND is beginning

D. NAPIER AND SON LIMITED, LONDON, W.3
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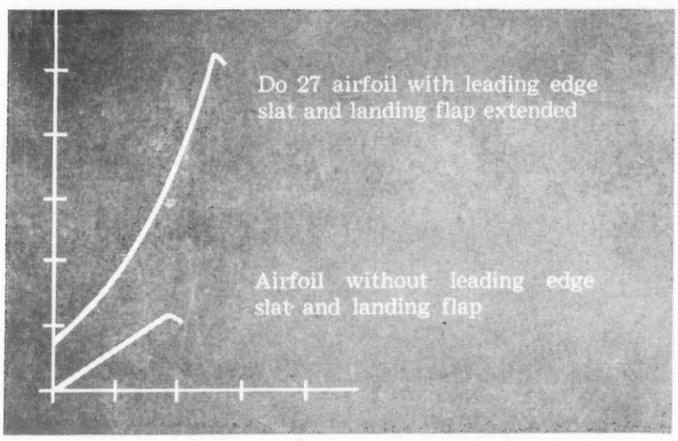

Another outstanding feature of the Do 27, besides its exceptionally wide speed range — difference between maximum and stalling speed — is its harmless behaviour in the stalled condition.

The leading edge slats and double slotted landing flaps give a high lift coefficient (picture). The ample-sized tail surfaces on an effective lever arm, the long fuselage, ensure good controllability, even in the maximum lift range. These important pre-requisites for safe low-speed flight and short landings are characteristic of the Do 27.

THE SINGLE-ENGINE GENERAL PURPOSE AND TOURING AIRCRAFT WITH MAXIMUM SAFETY

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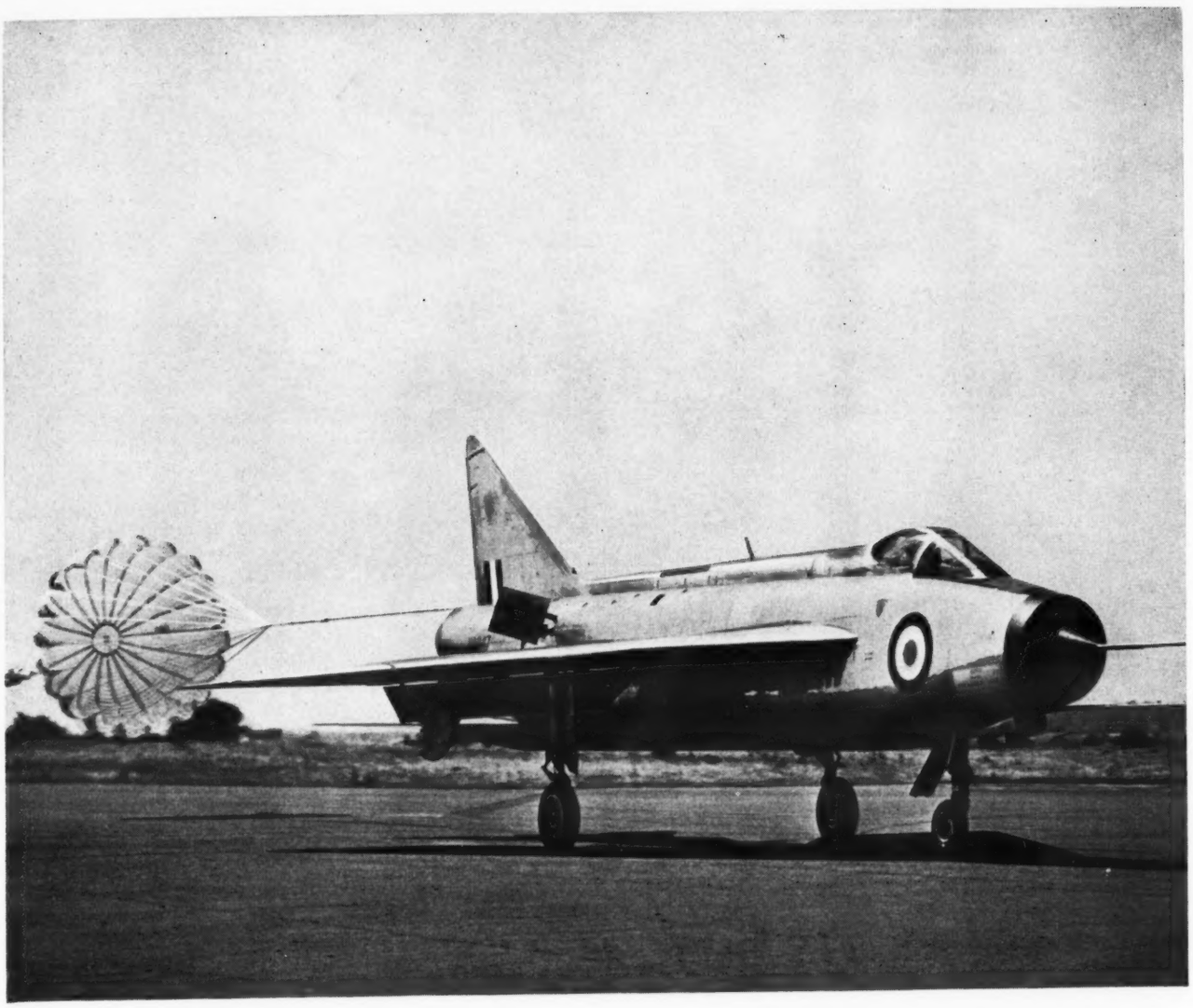


WHAT LENGTH OF RUNWAY DOES THE P.I. NEED

Thanks to low speed wind-tunnel and other development work at Warton, the P.1. is so easily handled that it is regularly landed and brought to rest in not much more than half the length of the present RAF fighter runway.

Design starts from an attitude of mind

'ENGLISH ELECTRIC' aircraft

A MEMBER OF THE ENGLISH ELECTRIC AVIATION GROUP

Missilitis is Catching

The times are so serious that it is impossible to take them seriously all the time. Praise is therefore due to the "Frankfurter Neue Presse" for dropping the usual seasonal platitudes in favour of some pithy comments by *Werner Fink;* the well-known European political humorist welcomed the New Year with a series of jesting truths, winding up with the words:

". . . Let us not be too hard on the Old Year or too extravagant in praise of the New . . . May 1958 bring peace between those men whose whole thoughts and efforts are devoted to preventing war. We expect that everything will be better in the New Year: better fire arms, better A, B and H bombs. And let us rejoice that our expectations are so often . . . not fulfilled."

If the whole affair were not so damnably serious, the billets-doux which Russia's "little father" and Uncle Sam (and his friends) have been exchanging so industriously since December 10th could be described as in keeping with Werner Fink's New Year wishes: peace between the men whose whole thoughts and efforts are devoted to preventing war. Ultimately they will achieve peace.

*

Once again Marshal Bulganin proposes disarmament, and once again his Western correspondents would honestly welcome such disarmament. There is only one snag: each would like to be sure that both sides will in fact disarm; it was this basic desire which threw them into each others arms in Geneva in the summer of 1955. The main question to be considered in the preliminary work for a new disarmament conference is again whether the Soviet Union is willing to accept the principle of inspection on the ground and from the air. So far it has steadfastly refused to agree to control within its own territory.

The United States President was even more explicit in his reply, published on January 13th, 1958, to his Russian colleague's note of December 10th, 1957. He stated that there have been three occasions during the present century when wars could have been prevented if the United States had been "militarily strong and committed in advance to the defence of nations that were attacked."

*

Sputniks I and II, the still classified report by H. Rowan Gaither, President of the Ford Foundation, and the widely discussed report by Nelson Rockefeller, of the Rockefeller Foundation, on weaknesses in the United States' defence system, have made their impact. In mid-1957 the Pentagon, at President Eisenhower's request, worked out an economy programme containing the germ of a promise for peaceful developments. By the winter of 1957 the undisguised Russian threat embodied in the existence of a Russian intercontinental ballistic missile had thwarted American peace hopes. The legacy of the economy programme includes cuts in arms production, three million unemployed, recession in civil markets and crisis signals.

The President's State of the Union message of January 9th reveals a new caution. It calls for:

- Reorganization of the defence structure in the direction of a unified control for the entire military machine;
- Acceleration of the defence effort, in particular as regards the guided missile and rocket programme, development of new aircraft and atomic-powered submarines and cruisers; encouragement of research and development;
- Greater economic and military aid to foreign countries, etc.
- And finally, increased cooperation between all nations in the cause of peace.

Once again the helm has been thrown over. After initial economies, an extra $ 1,300,000,000 has now been granted for the current fiscal year, and the budget proposals for the forthcoming fiscal year (from July 1st, 1958) include a new record total for defence expenditure.

*

The Russian adventures in space and the evidence they supply of the existence of Russian long-range rockets have borne fruit: "missilitis" is spreading... The repercussions are discussed by competent writers later in this issue.

*

The attitude of the two Scandinavian N.A.T.O. members, Norway and Denmark, during the December Conference also did not escape the Russians; these two countries opposed the installation of rocket launching ramps on their territories and recommended renewed negotiation with the Russians. But Sweden, the most important of the Scandinavian countries, was not present to put forward her views, as she is not a member of N.A.T.O., but pursues a policy of armed neutrality. In the above-mentioned exchange of notes between East and West, Sweden could with clear conscience point to her neutral attitude and offer her services as mediator. This small nation, whose love of peace is unchallenged, is willing to make sacrifices for its armed neutrality and possesses one of the most modern arsenals of weapons of its own manufacture.

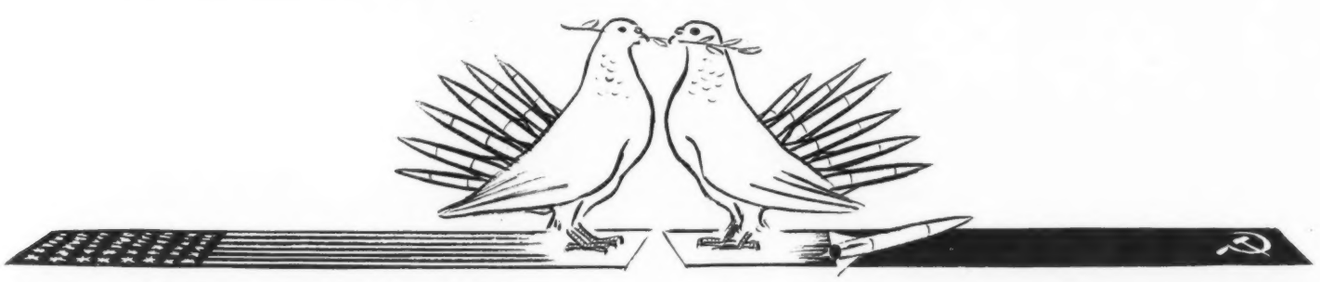
In view of the place Sweden has won for herself, the Editors felt that a closer examination of her defence planning, in particular as it concerns her Air Force, was well warranted at the present juncture.

*

In order to defend her neutrality, Sweden will continue to arm; so will the others, until some day they really do sit down to negotiate seriously.

The coming year will of course bring much better fire arms, A, B and H bombs. Yet despite "missilitis", the manned aircraft—as explained in a later article—will continue to rule the air for many years to come.

EEH



SWEDEN

Neutrality demands Sacrifices

At the end of October 1957 General Nils Swedlund, Commander-in-Chief of the Swedish Forces, submitted a long-term plan for the reorganization of the Swedish Armed Forces, at the same time proposing to the Government estimates for the 1958/59 defence budget of 2,740,000,000 Swedish crowns, i.e. 430,000,000 crowns in excess of the present budget year. Under the principles of the long-term plan, the annual credit will be divided between the three armed forces as follows: Army 36 percent; Navy 13 percent; Air Force 40 percent; common budget items 11 percent.

Although these budget demands total less than 5 percent of Sweden's national income, and considerably less than the annual amount originally suggested in 1954 for the armament programme—as a result of inflation—they are regarded as a crushing burden by both Parliament and the private citizen. Even more so as at the present time Sweden is undertaking an extensive social programme (old age pensions, reduction in taxation, etc.). Fierce debates on armament financing are imminent in the Swedish Parliament, but Government and military officials have no other choice than to stand by their decision and insist on the proposed defence budget. Why?

Because in the case of war Sweden can count only on her own arms—after the end of World War II she resumed her traditional neutral attitude, defining this neutrality as "absolute freedom from alliances".

As this idea of neutrality is decisive for Swedish armament needs, its history should be recapitulated briefly.

*

A brief, clear summary of the situation can be found in an article* published in 1952 by Professor Oesten Undén, Swedish Foreign Minister. Professor Undén, who represented his country in the League of Nations from 1921 until 1939, and took over the Foreign Ministry in 1945, can be regarded as the promoter of the present-day form of Swedish neutrality. As early as 1945, when Sweden joined the United Nations, Undén presented a governmental declaration to the Swedish Parliament, the most vital sentence of which was the following: "...Should, contrary to all expectations, there be a tendency within this organization towards division of the great powers into two camps, our policy must be to avoid being driven to join such a group or bloc formation".

Three years later Swedish independence had to face its first crucial test. Sweden, who since the end of the war had stood up for an extensive Northern cooperation in the non-military field (legislation, social policies, etc.), took the first steps towards coordinating Scandinavian defence. At that time Stockholm suggested to the Danish and Norwegian Governments that a defence pact be drawn up on the basis of permanent independence of the other powers. In other words, in the case of a world conflict the three Scandinavian powers should attempt to keep out of the war. Only if one of these three powers were attacked should the other two take part in the conflict.

The discussions on this project were already well advanced—the Conference of Ministers had met three times, the delegates for a "Scandinavian Defence Committee" had been chosen, a continuation of the Swedish defence line (Gällivare, Lapland—Boden, Gulf of Bothnia, along the Norwegian Lyngen Fjord to the coast of the White Sea) had almost been agreed upon—when Sweden suddenly called off the movement that she herself had started. Norway had in the meantime decided to accept America's arms aid and to join the Atlantic Pact. Soon afterwards Denmark followed suit. Sweden was thus left to provide her own defence unaided, a situation which has remained unchanged ever since.

This is the reason why Sweden must continue to depend on her own efforts for all types of armament and is obliged to demand heavy taxation from her population. Whether for equipping ground troops, air or naval forces, or procuring aircraft or robot weapons, Sweden is not prepared to accept a loan from the West and prefers to put up with a ten-year delay, in the costly and time-consuming field of atomic armament, rather than to consider the supply of material from abroad. President Erlander's answer was "No" when Conservative leader Jarl Hjalmarson asked whether the urgently needed atomic equipment should not be obtained from the United States. That Sweden can even consider adopting such a policy is solely and simply because of the high standard of her industry, in particular her aircraft industry.

*

The full consequences of Sweden's "splendid isolation" policy were not allowed for until the 1954/64 ten-year plan, which proposed an "allround armament", costing an average of 2½ billion Swedish crowns yearly for the modernization of the three Armed Forces. From that time onwards the Air Force received the lion's share.

A guided missile programme for the air and naval forces was outlined in principle, proposing the following developments: air-to-surface rockets (Attackrobot) for strike fighters; air-to-air rockets (Jaktrobot) to be fitted in all fighter aircraft; anti-aircraft rockets for high altitude (Luftförsvarsrobot); naval guided weapons (Sjörobot) for destroyers, and guided weapon batteries for coastal defence. It was naturally realized that it would be impossible to defend Sweden's territory effectively without manned aircraft. Therefore it was decided to procure all-weather fighters as well as to increase the number of aircraft in each combat wing by 50 percent.

The most recent modernization plan, submitted by General Swedlund in October 1957, is also based on these principles.

Despite the fact that economic considerations compel certain cuts in the defence budget demands of the three Armed Forces, as well as a modest reduction in personnel and materiel, the basic principle of a *complete* armament for "independent" defence against every kind of attack will remain unchanged.

Once this background becomes clear, it is possible to understand the principles behind the aircraft procurement plan for the Swedish Air Force, which are described in the following article by a Swedish Staff Officer. Contrary to the European N.A.T.O. powers, Sweden cannot content herself with the production of lightweight aircraft for special missions. She needs interceptors and strike fighters with adequate performance and armament to carry out any required mission.

* "Die Bündnisfreiheit Schwedens"; in the German monthly magazine "Aussenpolitik", 1952, No. 5, p. 277 etc.

Professor Oesten Undén, who became Foreign Minister in 1945, is the father of Sweden's concept of neutrality.

General Nils Swedlund, Commander-in-Chief of the Swedish armed forces, prepared the first long-term expansion plan for Sweden's forces in 1945, and the second in 1957.

Lieutenant General Axel Ljungdahl, Commander-in-Chief of the Swedish Air Force, must ensure a proper balance between manned fighters and missiles.

Major General Lennart Peyron, Chief of the Air Staff, bears the heavy responsibility for planning defence against air invasion.

The Future of the Swedish Air Force

By Major S. E. Alm, Defence Staff, Stockholm

The author joined the Swedish Air Force in 1939 and was commissioned in 1942. Having twice commanded the F6 strike wing, he became an instructor at the Air Force College from 1954 to 1957 and has since been adjutant to the Swedish Commander-in-Chief. He won the Swedish gliding championship in 1945. Editors.

Swedish Defence Plans

Yesterday's fighter carried something like fifty electronic tubes where today there are about three hundred, but nobody knows for certain how many will be required in tomorrow's fighters. It is known, however, that the costs will be high, very high. Technical development has already brought about a great increase in expenses, and this increase is becoming more and more pronounced.

There are three solutions to this problem: an increase in appropriations, a reduction of the organization, or a reduction in quality. In 1954 the Supreme Commander for Sweden's defence submitted to the Government a proposal for the future development of the country's defence. In his proposal the Supreme Commander stated that reduced quality was unacceptable, but suggested a certain reduction in the organization together with an increase in appropriations. To cope with the continuous cost increase defence appropriations should, in principle, be allowed to increase at the same pace as the gross national product and, in the proposal, a 2.5 percent increase was given as the minimum figure. For several reasons no decision was taken on the basis of this proposal and, in March 1957, the Supreme Commander was asked to modernize the proposal and at the same time submit other less expensive alternatives. This redrafted proposal, which in general covers a ten year period, has recently been made public. In this article the less expensive alternatives will not be dealt with further as they are considered unacceptable by all responsible authorities.

In an introductory study, the Swedish Supreme Commander states, *inter alia,* that the availability of nuclear weapons will have an increasing effect on strategy as well as on tactics. Guided missiles will partly replace both aircraft and artillery of various kinds but, on the other hand, it is noted that the conventional weapons are being developed further for use in those situations, or to solve those problems, for which the new weapons are not suitable. If a defence force is to be able to do its job it cannot afford to ignore the rapid technical developments and, although this poses certain difficulties for a small nation such as Sweden, there are possibilities of her finding solutions which are both technically and economically feasible.

Although a defence organization should be as versatile as possible one must, in the face of limited resources, place the emphasis on a rapid build-up of power in the initial stages of war, rather than on endurance. In spite of the fact that considerable appropriation increases are called for in the Supreme Commander's proposals, reductions are planned in all three military services. The Army would be reduced by about 15 percent, the Navy by about 25 percent, the Air Force units by about 5 percent and the total number of aircraft by about 20 percent. The Air Force's share of the appropriations is increased, however, and appropriations for research and new weapons are also considerably increased. The production of nuclear weapons is also proposed.

The possible attack

When the Supreme Commander discusses the possible methods of attack in his proposal it can be noted, although not specifically stated, that he does not anticipate any attack from the direction of Norwegian or Danish territory so long as those countries enjoy a democratic Government and continue to control their own territories. The methods of attack which would have the most rapid effects against Sweden are aircraft, missiles and invasion, and a combination of these three is the most dangerous. Other methods of aggression, e.g., isolation combined with the cutting of supply lines could only be effective over a long period.

Attacks by aircraft or guided weapons appear to be the greatest danger; they could be launched without warning and would have a great effect if they found Sweden unprepared. In addition to the necessity for a high degree of preparedness in the air defence, this threat also poses heavy demands for civil defence, particularly as regards a rapid evacuation service.

An invasion of Sweden could be effected by land, sea or air. Previously the Swedish authorities have considered a seaborne invasion as the greatest danger, as this could be carried out with great power against the most sensitive areas. This condition still exists but, due to technical developments, it appears that the probability of a seaborne invasion is decreasing in favour of the probability of an air invasion.

The air defence

The air defence is here defined as an organization which shall be able to protect Swedish territory against an enemy's aircraft and guided weapons attacks. In this connection some details of Sweden's territory are important. The country is long and narrow, ranging from 180 to 250 miles in width, with a length of 1,000 miles from north to south, a distance comparable to that separating Berlin and Sicily. The surface area is 175,000 square miles, about one-and-a-half times as large as Italy, and the population of seven million averages 44 inhabitants per square mile; by comparison Great Britain and Western Germany average 500. In fact, however, over half of Sweden's inhabitants live in densely populated areas, mostly in the Southern third of the country, but there are large unpopulated areas, parti-

A squadron of Saab A 32 *Lansen* all-weather strike fighters at a Swedish air base.

Swedish aircraft must be adaptable to the most varied tactical tasks and permit of modification to keep pace with technical development. Picture shows the piston-engine Saab J 21 which came out in 1943 as a fighter and ground attack aircraft and was fitted with a jet engine in 1947.

Two examples of anti-invasion defences from the 1957 Swedish defence plan. Left: concentration of forces in southern Sweden, with hedgehog positions in the north. – Right: disposition of forces to meet an attack against central Sweden.

cularly in the North, containing vulnerable communications. From an air defence point of view certain areas are more important than others, but no areas can be completely neglected; at the same time both the sea and the distance from the potential enemy's bases ensure relatively good warning time, although these times decrease with technical development.

A highly prepared and active air defence is of very great importance and should, together with the civil defence, provide the Swedish Government with the power to stand firm against short-term ultimatums and threats of atomic attack against population centres. Additionally, the air defence should have a deterrent effect by inflicting losses on the enemy, thus forcing him to use his most modern equipment and to operate in such a way that the effect of his air weapons is reduced. The only possibility of defence against certain types of guided weapons launched against Swedish territory is, for the time being, the attack of the launching stations with fast strike aircraft.

Surface-to-air missiles must be procured as soon as they are considered technically and economically suitable. Piloted fighters, says the Supreme Commander, have a great versatility compared with other air defence weapons and will continue to be required in the future, even though their role may be changed; fighter aircraft have a comparatively greater range of action and can be rapidly concentrated in different areas, an extremely valuable possibility in a country like Sweden. Arming the aircraft with air-to-air missiles considerably increases the combat value of each single aircraft and, by an increase in the number of pilots, a greater number of missions can be carried out in wartime. Against this background of high procurement costs for both aircraft and missiles, the Supreme Commander proposes an approximately 20 percent reduction in the number of fighter aircraft. This mainly concerns the reserve aircraft; for the wartime organization the number of fighter squadrons would be reduced by 10 percent, and it is proposed to disband three of the thirty-three peacetime fighter squadrons, over a longer period. The reduction should be completed by 1965.

The reasons for these reductions are primarily economic. The fighter aircraft plus air-to-air missiles is today considered a more economical and efficient means of combat than surface-to-air missiles defending a given geographical target.

A considerable increase in the number of air bases is proposed to permit wide distribution and high mobility with the possibility of rapid concentration of the fighter units in various parts of the country; it is intended to utilize widened highways to reduce the costs. Air observation and fighter control organizations must be continuously modernized but the cost will be so great that certain parts of the country must accept a simpler organization within the overall plan. Efficient electronic counter measures are also proposed.

Defence against invasion

Defence against air invasion will principally be the task of the fighter defence which, due to Sweden's large surface area, must be given priority. It has previously been suggested that certain units with obsolescent fighter aircraft should be retained for the task of defence against invading transport aircraft and also for use against ground targets. The new proposal makes no mention of this, but the possibility is not excluded.

Defence against seaborne invasion continues to be the task of the Swedish Navy, in collaboration with the Air Force. In 1954 the Supreme Commander proposed that the air strike forces should take over part of the role of the surface vessels for defence against invasion, and this system continues; the air strike force now has new aircraft as well as air-to-surface missiles and comprises a peacetime strength of 12 squadrons whose training and employment has been concentrated solely against ground and sea targets. The fighter squadrons have also received certain strike training in order to strengthen the strike forces if the situation becomes critical, and this system will continue. Sweden has placed great emphasis on the additional strength to be derived from the fighter force for invasion defence, and this has an effect on the design, range, weapons and fire control.

No changes are proposed in the air reconnaissance force which must maintain its high standard.

Flying equipment

The Supreme Commander's proposal deals only generally with the future equipment of the Swedish Air Force. Although the proposal covers a ten-year period, only the first four years have been studied in detail. The proposal states that as a basis for economic estimates a one-for-one replacement of equipment must be considered, although this position may perhaps change when the situation becomes clearer. Sweden has become increasingly self-supporting in combat aircraft, although any small nation is faced with consider-

Substantial portions of the defence funds are used for the provision of underground installations for the Air Force's vital equipment. Underground hangar for the maintenance and repair of J 34 *Hunter* day fighters.

The *Lansen* can carry two Swedish Type 304 air-to-surface missiles.

The Swedish Navy is also preparing to operate guided missiles. A Type 315 missile ready for launching aboard the destroyer *Småland*.

able difficulty in producing modern and effective combat aircraft which are comparable to those of the great powers, at the same time keeping costs within reasonable limits. The development of a modern aircraft must be carried out under pressure of time but with a parallel precaution against failure in view of the costs and availability of technicians; therefore each new basic design must be adaptable for various tactical roles and permit modifications giving better performance.

There are several examples of this. The Saab J 21 fighter, which was first test flown in 1943 powered by a Swedish-built Daimler-Benz 605 and a pusher propeller, in 1947 made its first flight as a jet fighter powered by a British de Havilland *Goblin* turbojet engine. The current Swedish standard fighter, the Saab J 29 "Flying Barrel", which was first delivered to the Air Force in quantity in 1951, is in its latest version, the J 29 F, equipped with a Swedish afterburner and other improvements. In performance it can almost be regarded as a new aircraft; the rate of climb has been more than doubled and it is now superior to many foreign fighters, e. g., the Hawker *Hunter* (also used in Sweden). In spite of the fact that the J 29 will fairly soon be replaced by new aircraft, a great number of J 29 fighters have been modified to J 29 F standard during the last two years.

The aircraft currently being delivered in quantity to the Swedish Air Force is the Saab A 32 *Lansen* all-weather strike aircraft. All strike squadrons are equipped with this aircraft, and deliveries will be completed during this year. Then will follow delivery of a photographic reconnaissance version and a night fighter version, the latter fitted with a considerably more powerful *Avon* engine than the strike version. The total number of squadrons to be equipped with this new night fighter version has not been stated. Probably the new equipment will first be issued to the three squadrons now flying the obsolescent *Venom* night fighters.

The next basic aircraft type now undergoing development testing at Saab is the single-seat J 35 all-weather fighter. This extreme double-delta aircraft, first test-flown in October 1955, holds great promise. It has not been officially stated whether the aircraft is to be produced also in reconnaissance and attack versions, but the Supreme Commander's proposal indirectly indicates that the fighter version will be provided with some form of strike armament, probably an air-to-surface missile. Following statements by leading officials in Sweden, some publicity has been given to the fact that the J 35 may be the last fighter aircraft to be developed in Sweden. From the proposal, it is evident that so far no decision has been taken in this connection. As has been the case with previous aircraft types, there will be great possibilities, if required, of using the J 35 as a basis for completely new versions for different tasks.

The double-delta design offers relatively generous space for equipment and fuel, and the aircraft has also shorter take-off and landing runs than its nearest predecessors; the speed has been unofficially indicated as more than 1,000 m.p.h. or Mach 1.5*. The take-off weight has been officially given as 8 to 9 tons, depending on armament alternatives.

The suitability of the very light aircraft of the *Gnat* class has been discussed in Sweden, where it is particularly necessary to keep the costs down. Up till now, the opinion has been that such an aircraft does not permit a powerful enough armament and, additionally, the radius of action is too short for Swedish conditions. The problem must also be considered against the background that Sweden does not dare to experiment too much. Compared with foreign aircraft types of similar performance, both the *Lansen* and the *Draken* can be considered as relatively light aircraft. The question of a very light (and cheap) fighter has not been completely written off; the greatest problem seems to be to provide a sufficiently light air-to-air missile and preferably also a similar air-to-surface missile.

As far as the armament of fighters is concerned, current Swedish requirements are that one hit only should be sufficient for destroying the target. This means that future fighters must be armed with air-to-air rocket projectiles or guided missiles. Until combat economical efficiency of the air-to-air missile is acceptable, it can be expected that both armament alternatives will be utilized.

* At a press conference on December 18th, 1957, General Ljungdahl revealed that a new version, scheduled for service in the sixties, will have a speed of close to Mach 2.

Future plans

The Government decisions on the new defence are awaited with great interest. The Swedish people have a great will to defend themselves and, as a support to the alliance-free policy, on which the nation is agreed, a modern and strong defence is needed. Many people are discouraged by the costs and support some of the cheaper alternatives, whereby greater reductions are imposed on the Army and Navy than on the Air Force. The Supreme Commander in turn has stated that Sweden, for the present, must carry a double burden, i.e., maintain the present defence on a reasonable strength level and also carry out the research required for the development of new weapons, primarily nuclear. When these new weapons are ready for operational use and a sufficient war reserve is available, then—but only then—will it be possible to carry out other reductions in the defence organization.

It is clear that this is not a question of overwhelming expenditures, since the finances involved in the Supreme Commander's proposal represent less than 5 percent of the gross national income. Of the appropriations, the Army receives 36 percent, the Navy 13 percent, the Air Force 40 percent, and 11 percent is earmarked for mutual purposes, primarily research. For the ten-year period 1957—1967, the total cost will amount to about 30 billion Swedish Crowns (US $ 6,000,000,000).

Concluding his proposal, the Supreme Commander states, *inter alia:* "The divergent opinions expressed concerning the consequences of technical development in the character of a future war in general, and for an attack that might be made on our country, give an indication of the difficulty of assessing the situation. Therefore, it is necessary to avoid one-sided solutions with the intention of providing only for either the air defence or invasion defence. It is essential that, within the finances available, a solution of the defence problem is found which provides defence ability in both respects and also caters for continuous adjustments in the development of new weapons, primarily nuclear and guided missile systems".

SWEDEN

The Saab-35A Draken

Backbone of Sweden's air defence

Discussing Sweden's future air defence, Lieutenant General Axel Ljungdahl, Commander-in-Chief of the Swedish defence forces, stated in December 1957 that the new Saab-35A (J 35A) *Draken* supersonic fighter will be in operation with the Swedish fighter units in about a year's time. At the same time he also revealed that by the early sixties the Air Force would have an improved version of the *Draken*, equipped with air-to-air rockets and guided missiles and capable of speeds close to Mach 2. In addition all *Drakens* are to have a new fire control system for collision course tactics, so that the striking power of the fighter units will no longer depend only on their speed advantage over enemy bombers. Also, such equipment greatly reduces the risk of being shot down during the attack. Though by the mid-sixties bombers can be expected to have speeds of Mach 1.5 to 2.5 and operating altitudes of around 65,000 ft., such speeds will probably be maintained only for five to ten minutes. In any case fighters of the *Draken* category should continue to meet the needs of Sweden's air defence during the years to come.

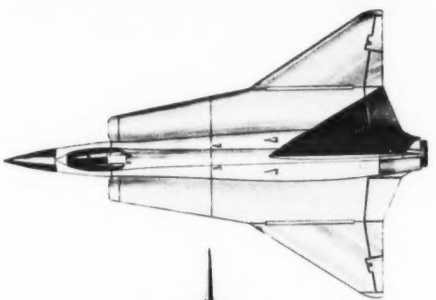
The Swedish Air Force's decision to develop the *Draken* as a long-term project in a number of different versions is based on four considerations:

1 – The basic design reveals excellent development potential as regards utilization of space (e. g., substantial wing thickness at the root; large fuselage volume, etc.), so that the same configuration can house different installations.

2 – The low wing loading enables a high military load to be carried.

3 – Flight tests have proved that the drag of the double-delta wing remains relatively low even in the supersonic range. For example, even the prototypes with less powerful engines have attained respectable speeds, which will be greatly exceeded by the production model with more powerful engine.

4 – The Saab-35 has proved an economic proposition in both first cost and operation; its operational potential and combat value are equal to those of other heavier and more costly aircraft types.



Technical data of the J 35A

Powerplant: one Flygmotor RM6 (Rolls-Royce *Avon* licence) with Swedish afterburner

Span	30.8 ft.
Length	46.6 ft.
Wing area	538 sq. ft.
Gross weight	8 to 9 tons

A Saab Aircraft Company official publication reveals that under normal flight conditions the *Draken* cannot be stalled. Its outstanding low-speed qualities enable it to be operated from relatively small airfields. Stalling speed near the ground is 130 m.p.h.; average landing distance with brake parachute (carried as standard equipment) is not more than 1,970 ft. During a recent demonstration minimum landing distance was only 1,480 ft. Other qualities listed are: very high taxi speed, wide speed range (greater than that of other existing fighters, according to SAAB), good controllability in the transonic range, excellent stability in all speed ranges (hence a good gun platform) and no compressor surging on firing the cannon.

•

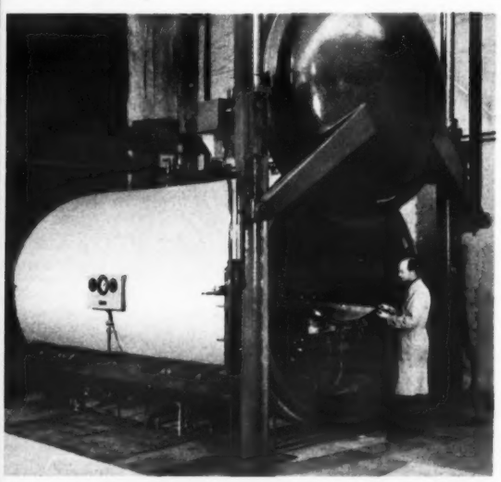
For the production of the *Draken*, SAAB has introduced a number of time and cost-saving methods. The wing skin consists of bonded honeycomb sandwich sheet manufactured in a fully up-to-date shop with "curing" ovens and automatic presses. For the production of the highly stressed bulkheads for the centre and rear fuselage portions a new type of milling machine has been designed, which produces a continuously variable flange angle.

Finally, to cut down the time between development of the prototypes and the first production aircraft, an entirely new method of manufacturing parts ("extended tooling") has been introduced, using precision boring machines, which are usually employed only for making tools. To reduce the number of jigs to be built specially for this type, SAAB is using five Wharton tool sets, each consisting of 150 standard parts, with the aid of which machine tools (presses, boring and milling machines) can be rapidly set up, without using tool drawings.

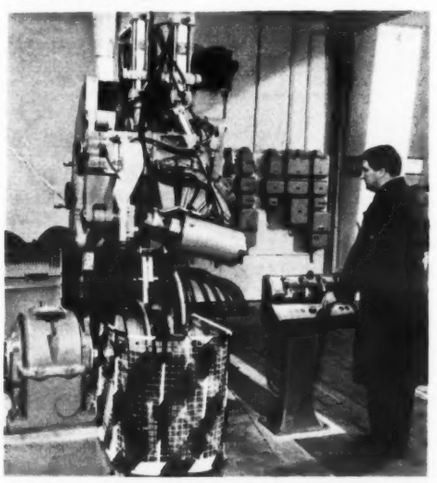
The extent to which production can be speeded up by such methods is revealed by the Saab-35A production model. SAAB received the first Air Force order for the Saab-35A in August 1956, production of parts began one month later, and the first production model will probably have made its maiden flight by the time these lines appear in print.

A detailed article on the *Draken*, by Erik Bratt, the aircraft's chief designer, will be published in the March issue.

Special ovens for curing bonded wing sheets with sandwich filling.



Milling machine to produce fuselage bulkheads with variable flange angles.



A Firm Basis for Sweden's Air Power

By Bryan R. Noton, D.C.Ae., A.F.R.Ae.S., A.M.I.Mech.E.,
Senior Scientific Officer,
The Aeronautical Research Institute of Sweden (FFA), Ulvsunda.

The following article describes the development and the work of Sweden's aviation industry and research efforts which form the basis for the continued development of the air power of this Scandinavian state. In addition to the two largest concerns—SAAB and Flygmotor—the article discusses the important research centres, aeronautical education and the various professional bodies concerned with aeronautical science. The author holds a senior position in Sweden's Aeronautical Research Institute and is the founder of "The International Committee for Aeronautical Sandwich Construction and Bonding". Editors.

To form a clear appreciation of the contemporary aircraft industry it is first necessary to recall the origin of Sweden's military aviation activity. The official birthday of the Royal Swedish Air Force (Flygvapnet—F.V.), July 1st, 1926, does not coincide with the beginning of Swedish military aviation; the country's first military aircraft was a Swedish-built replica of a Blériot monoplane, used by the Navy in 1911 at Malmslätt, and the Army received its first aircraft, a French Nieuport IVG monoplane and a Breguet U1 biplane, in 1912. During World War I, several aircraft of French and Swedish design were produced in three private companies and, by 1917, the aircraft factory of Dr. E. Thulin in Landskrona was exporting both aircraft and engines; for example over 120 engines were exported to Holland. Between 1915 and 1919 this factory manufactured 100 aircraft and 700 aircraft engines, mainly of its own design. However, soon after the first World War these activities ceased, and only one of the three factories continued production, this being at Malmslätt, the present location of one of the Royal Swedish Air Board's Technical Maintenance Depots (Centrala Flygverkstaden Malmslätt). The Air Force Museum is also located at Malmslätt.

In the early 1920s a new factory was founded at Lidingö, near Stockholm, under the title Swedish Aero Company (Svenska Aero Aktiebolaget)—not to be confused with the now famous SAAB Aircraft Company (Svenska Aeroplan Aktiebolaget), Linköping, which will be discussed later. In 1925 another company, A.B. Flygindustri, was formed near Malmö. In the early days these factories produced aircraft for export, but their later efforts were devoted to the production of training and combat aircraft for the Swedish Army and Navy.

In 1930 the Swedish Aero Company and A.B. Flygindustri factories ceased operation; the Swedish Railway Works (A.B. Järnvägsverkstäderna—A.S.J.A.) opened an aircraft division at Linköping and this proved to be the forerunner of today's Svenska Aeroplan A.B.—SAAB.

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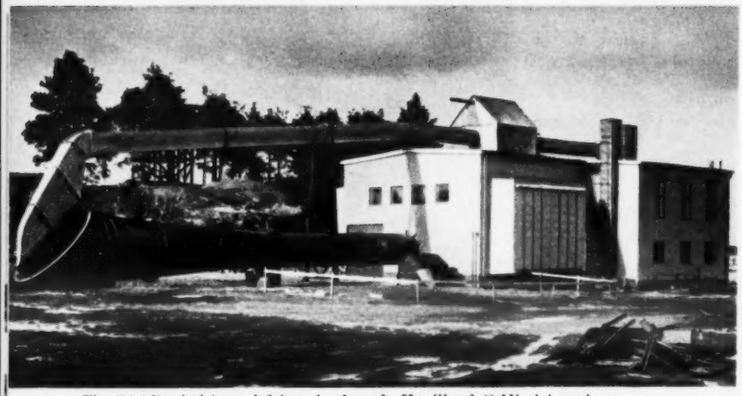
As a result of experience gained during the first World War the Swedish Parliament (Social Democratic) inaugurated the Royal Swedish Air Force whose present Commander-in-Chief is Lieutenant General Axel G. Ljungdahl. By 1936 the Air Force had acquired a total of almost 350 aircraft including 80 trainers based at the Ljungbyhed Flying School (Flygskolkåren); founded in 1915, and now one of the world's largest, the present title of the school is the Royal Swedish Air Force Flying Training School (Kungl. Krigsflygskolan). It is of interest to note that student flying training at Ljungbyhed costs the Swedish State 100,000 crowns ($1 = 5.18cr.) per capita.

The principal decision of the 1936 Air Force programme called for a considerable expansion in Sweden's private aircraft industry. The A.S.J.A. factory was greatly expanded, and the Bofors group of Swedish industries founded a new aircraft factory, SAAB, at Trollhättan. The Bofors Company was founded in 1646 and is famous for its 40-mm anti-aircraft gun which has been supplied in quantity to the major Western powers.

Part of SAAB's Linköping factory.

The history of SAAB

At the Bofors-founded SAAB works in Trollhättan, production commenced in the mid-thirties on the Junkers Ju 86K, while the A.S.J.A. Linköping plant built the North American



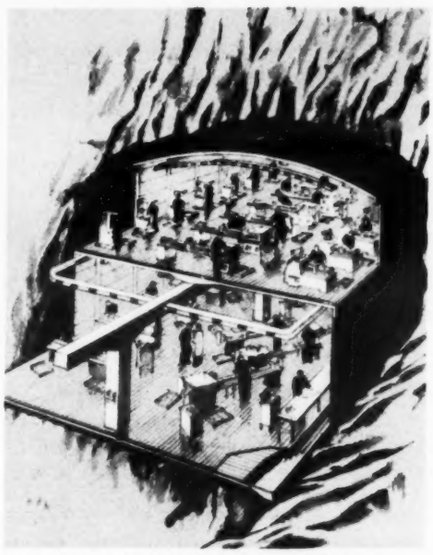
The SAAB wind tunnel driven by four de Havilland *Goblin* jet engines.

SAAB's aircraft equipment factory at Jönköping.

NA-16-4 and the Northrop 84-1 light aircraft under licence, and designed a new Swedish single-engined reconnaissance aircraft. In 1939 the SAAB and A.S.J.A. factories merged to form the present SAAB enterprise, with head offices at Linköping.

Following the mobilization of the Swedish Air Force in April 1940, SAAB concentrated on the development of the new J 22 fighter aircraft, which was delivered to the Air Force in September 1942. This aircraft, powered by a Swedish-built Pratt & Whitney *Twin Wasp* engine, had a top speed of 358 m.p.h. (575 km/h), and was assembled in one of the large hangars at Bromma Airport. The chief designer of the J 22, which went into production six months before the prototype made its flight, was Bo Lundberg, M.S., Hon. F.I.Ae.S., F.R.Ae.S., the present Director of The Aeronautical Research Institute of Sweden (Flygtekniska Försöksanstalten—F.F.A.).

During World War II SAAB developed several new types of aircraft of which the most noteworthy are the Saab-18A, a heavy twin-engined strike and reconnaissance aircraft, and the Saab-21A, a pusher propeller light strike fighter. The Saab-21A was one of the world's first aircraft to be fitted with a pilot's ejection seat. In 1944 SAAB began peacetime production with the modification of Boeing B-17 *Flying Fortresses* as a stop-gap civilian air transport; work then commenced on two civilian types, the Saab-90 *Scandia* 36-passenger commercial transport, and the Saab-91 *Safir*. The former made its first flight in November 1946, and the latter in December 1945. The Safir is in use with the flying training schools of several foreign air forces and, together with the *Scandia*, has been built under licence in Holland.



Sectional view of the SAAB underground factory.

The first Swedish-built jet aircraft, the Saab-21R (J 21 R), was first flown in March 1947 and was built partly to give the SAAB engineers in Linköping experience in designing the more modern and advanced Saab-29 (J 29) jet fighter; the latter first flew in September 1948 and was in production for five years.

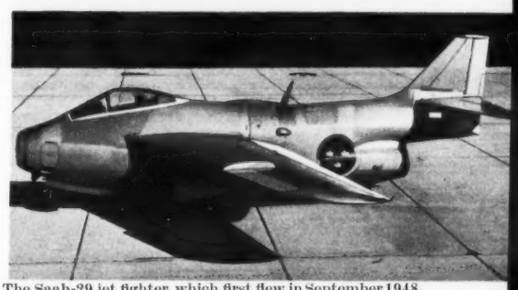
The J 29 has now been replaced on the production lines by the Saab-32 (J 32) *Lansen* all-weather fighter and ground attack aircraft, the first prototype of which made its maiden flight in November 1952. The two-seat *Lansen* has comprehensive electronic equipment for night and bad weather operations and has achieved super-

Assembly of wings for the *Lansen* all-weather and strike fighter; in the background are fuselages.

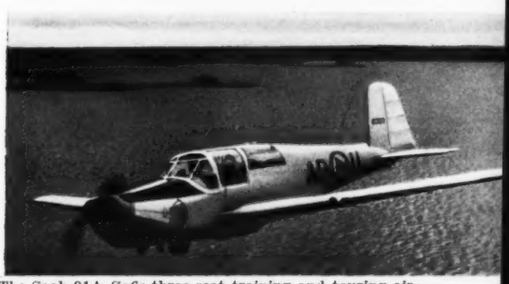
Part of the Svenska Flygmotor factory at Trollhättan.

The J 35 *Draken* single-seat supersonic fighter.

The Saab-32 B *Lansen* all-weather fighter.



The Saab-29 jet fighter, which first flew in September 1948.



The Saab-91A *Safir* three-seat training and touring aircraft.

The Saab-210 double-delta wing research aircraft.

sonic speeds in a dive. Even before the first *Lansen* squadrons were equipped and the last J 29s had left the factory, SAAB had test flown another new fighter—the J 35 *Draken*—a truly supersonic fighter with the company's double-delta wing configuration.

*

Today the SAAB Company is Sweden's only manufacturer of aircraft. The company is organized into three principal divisions; these are at Linköping (Head Offices: SAAB-L), Jönköping (SAAB-J) and Trollhättan (SAAB-T). Two further factories have also been purchased, at Gothenburg Port and Södertälje, about 18 miles south-west of Stockholm. The Linköping division, with its modern equipped underground production workshops blasted out of solid rock, is the core of Sweden's aircraft production. On the other hand, the Jönköping division, which was opened in 1950, is devoted solely to the development and production of aircraft equipment. As an illustration of the important part which the Jönköping division plays in the Swedish aircraft industry, it can be mentioned that the factory has designed and manufactured some 250 of the total of 350 items of equipment which are installed in the Saab-32 *Lansen*. All three main divisions mentioned above are undergoing considerable expansion and, for example, the Jönköping facility is being increased in area from 38,000 sq.ft. to a total of 97,000 sq.ft. At the Trollhättan plant, facilities are almost exclusively devoted to the production of the Saab-92 and 93 four-seater motor cars in the small car class, and the output of this factory is expected to reach over 10,000 cars in 1957; the Saab-93 is exported to the United States, amongst other countries.

In Sweden's aircraft industry, responsibility, proficiency and thoroughness are highly prized qualities. SAAB seeks to assure these qualities from the very beginning in its own trade school, where young men are given an extensive training course as a prerequisite to regular employment with the company. SAAB also offers a four-year course for aeronautical engineers, including university level education in a wide range of subjects essential to the aviation industry. The total number of SAAB employees is approximately 7,000.

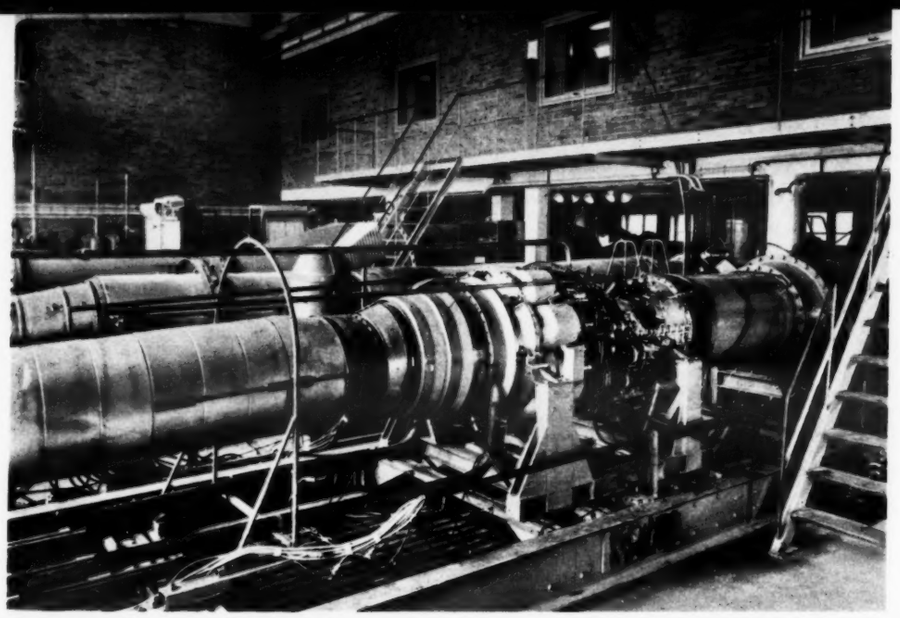
The President of the entire SAAB Aircraft Company is Tryggve Holm; at the Linköping division L. H. Brising, M.S., F.I.Ae.S., is Director of the Engineering Department and B. Johnson is Director of the Production Department. T. Faxén is Director of the Jönköping division, and S. Holm is Director of the Trollhättan division.

The grounds around Svenska Flygmotor's luncheroom at Trollhättan.

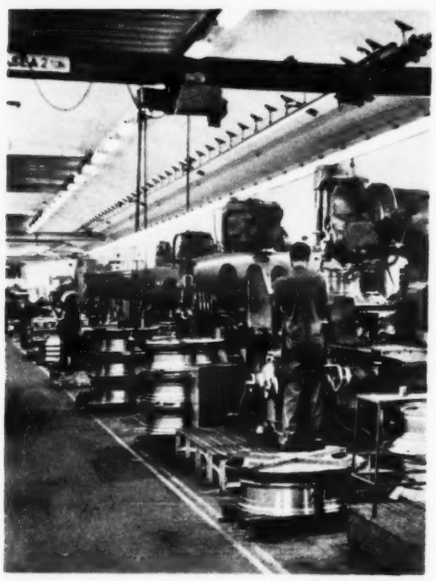
The Aero-Engine Factory

Sweden's sole supplier of aircraft engines is Svenska Flygmotor AB with head office and works located at Trollhättan. This factory was organized in 1930 by the Royal Swedish Air Board and the firm of Nydqvist and Holm; the new factory was given the title Nohab Flygmotorfabriker A.B. and began its activities by producing 40 aircraft engines for the Swedish Air Force. In 1941 a change of name was decided upon, and Svenska Flygmotor A.B. emerged, with a majority of shares being held by Volvo A.B., Sweden's largest motor car manufacturer; the remaining shares are now held by the Bofors concern.

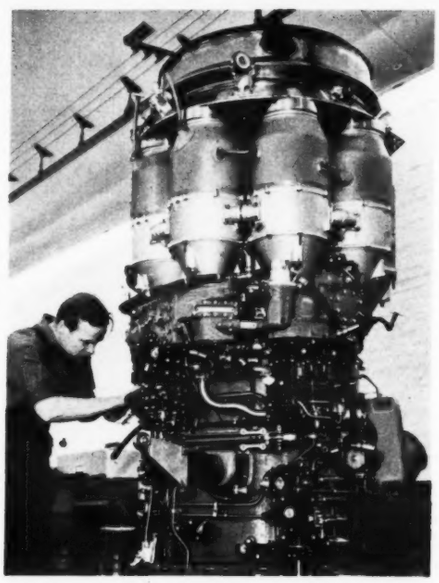
Svenska Flygmotor, which began producing British jet engines under licence in 1948, has now built well over a thousand engines of two types, namely the de Havilland *Goblin 3* (Swedish designation RM 1A) and the *Ghost* (RM 2 and



Flygmotor's testing department pressure rigs.



An underground machine shop at Svenska Flygmotor.



Final inspection of a Svenska Flygmotor licence-built Rolls-Royce *Avon*.

RM 2A). The production of these engines was completed in 1955 when the manufacture of a version of the Rolls-Royce RA 7 with afterburner (designated RM 5) was getting under way. This conversion in production from radial to axial flow turbojet engines has demanded the extensive procurement of new machinery to the tune of millions of Swedish crowns. Flygmotor has a very active research and development department with a transonic and supersonic ballistic wind tunnel for research work up to Mach 3.6. It is already known that Saab-29 fighters have been fitted with afterburners, and Flygmotor, in association with the Air Board, has been responsible for the development of this afterburner and the associated fuel system. With a weight of 286 lb. (130 kg), including the fire guard and the fuel system, this particular afterburner approximately doubles the rate of climb of the Saab-29 fighter; a licence for production of the fuel system has been sold to a large United States manufacturer. Other notable contributions by the research department of Flygmotor have been concerned with special alloy steels with great heat resistance, ferritic materials, austenitic materials and metal ceramic products.

Although a large proportion of Svenska Flygmotor's work has been concerned with the manufacture of engines under licence, much experience was gained by the company in the design of the Swedish *Dovern* and *Glan* jet engines. Both these powerplants were cancelled in 1952, but in 1954 G. Engellau, the former company Director and General Manager, indicated that several new engine types were being developed. The present President is E. V. Forslund, with G. Gudmundson, M.S., F.R.Ae.S., as Technical Manager and G. Hiort af Ornäs as Production Manager. Flygmotor currently employs approximately 2,000 people of whom some 1,300 are factory workers.

For the production of Rolls-Royce *Avon* engines two major factories have received subcontract work; these are Svenska Turbin Aktiebolaget Ljungström (S.T.A.L.) at Finspong and Gevärsfaktoriet at Eskilstuna. The *Dovern* powerplant mentioned earlier had a 9-stage axial-flow compressor with a static sea level thrust of 7,260 lb. (3,300 kg), largely designed by S.T.A.L. with Flygmotor collaborating in the later constructional stages.

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In reviewing the Swedish companies concerned with aviation developments the work of A.B. Malmö Flygindustri should be put on record. This company is located at Bulltofta Airport, Malmö, in the south of Sweden, and is concerned with the production of glassfibre laminates and wooden parts for aircraft, as well as the manufacture of steel fittings and the maintenance of aircraft. The company, General Manager R. C. Abelin, is now affiliated with Trelleborgs Gummifabriks A.B., the Swedish manufacturer of tyres and rubber fuel tanks.

The Research Establishments

Aeronautical research in Sweden was comprehensively covered by B. Lundberg, the Director of The Aeronautical Research Institute of Sweden (F.F.A.) in the October 1955 issue of "The Journal of the Royal Aeronautical Society"; in this paper the most important aspects of the research work at SAAB, Flygmotor, S.T.A.L., F.F.A. and the Royal Technical High School, Stockholm (K.T.H.) were discussed.

The Aeronautical Research Institute of Sweden (F.F.A.) was opened in September 1940 and is the Swedish equivalent of the United States National Advisory Committee for Aeronautics, but is under the jurisdiction of the Ministry of Commerce. The Aerodynamics Division has extensive modern facilities for research at subsonic, transonic and supersonic speeds, the chief of the department being E. Petersohn, M.S. The Structures Department is concerned with research and testing associated with airframes, and the chief is G. Wållgren, M.S. A third group, headed by Dr. G. Gustafsson, deals with the problems of measurement encountered by the other departments and also develops new and advanced measurement techniques. The Institute also has an Engineering Department headed by B. Reistad, M.S. The total personnel at F.F.A. numbers about 300, including a technical staff of 120, some 30 of whom have university degrees.

Sweden also has a further research organization —the Research Institute of National Defence (Försvarets Forskningsanstalt—F.O.A.), but for security reasons this institute's work and facilities cannot be discussed; it can, however, be mentioned that the Institute is divided into three departments dealing firstly with medical and chemical research, secondly with physical research and thirdly with electronics research.

Institutes of Technology and Professional Societies

Sweden has two colleges of technology, the Royal Institute of Technology (Kungl. Tekniska Högskolan—K.T.H.) in Stockholm with a 1955—56 academic year strength of 62 professors and 2,281 students; the second is Chalmers University of Technology (Chalmers Tekniska Högskolan—C.T.H.) in Gothenburg which in 1955—56 had a faculty of 37 professors and a student body of 1,668. It must be pointed out, however, that these numbers are distributed over a wide range of specialized engineering subjects and, for example, the civil engineering branch is very extensive. Of the two colleges only K.T.H. is concerned with aeronautics, and there are five departments of which the two most important are the Division of Aeronautics, headed by

Tryggve Holm,
SAAB Managing Director.

L. Brising,
Technical Director, SAAB.

B. Johnson,
Director of Production, SAAB.

E. V. Forslund,
President, Svenska Flygmotor AB.

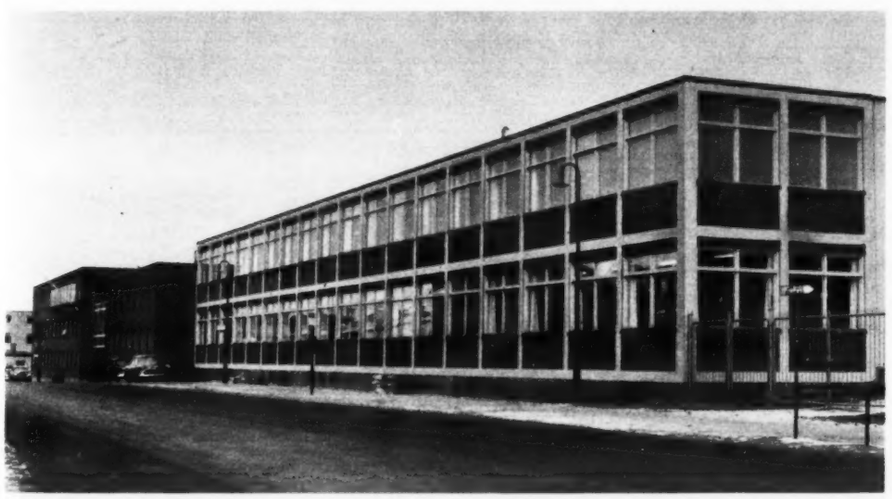
G. Gudmundson,
Technical Manager,
Svenska Flygmotor

G. Hiort af Ornäs,
Production Manager,
Svenska Flygmotor

B.K.O. Lundberg,
Director, F.F.A.

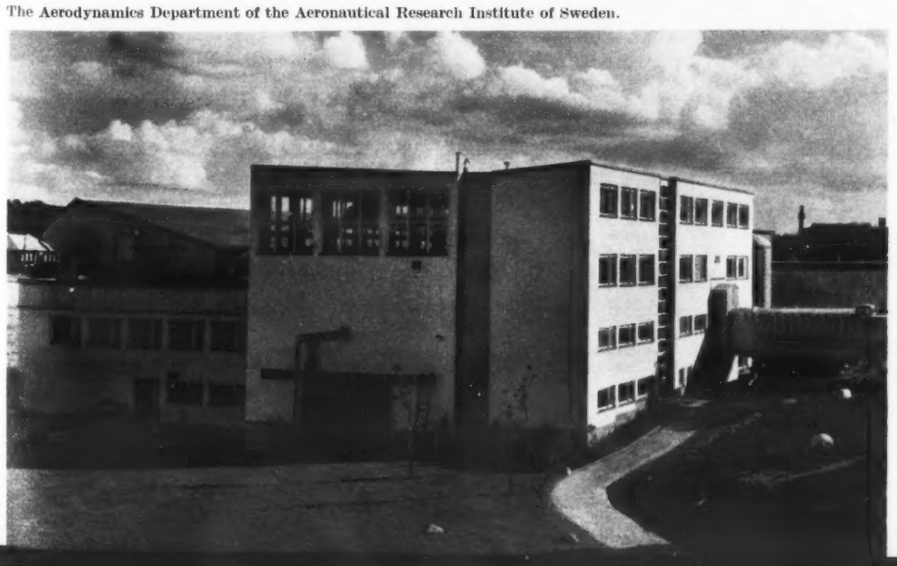
Major General N. Söderberg,
Secretary General of the
Royal Swedish Aero Club.

Bengt R. Olow, SAAB Chief Test Pilot.



External view of The Aeronautical Research Institute of Sweden with the very modern workshops in the foreground.

The Aerodynamics Department of the Aeronautical Research Institute of Sweden.



Professor S. Luthander, and the Division of Airplane Structures, headed by Professor T. Rand, D.Sc., A.F.I.Ae.S.; Professor Luthander also controls a research laboratory with an academic staff of 12. There are a number of other technical schools in Sweden of which the Högre Tekniska Läroverket at Norrköping offers a course devoted to aviation subjects, the principal lecturer being Gunnar Larsson, M.S.

Three professional bodies are directly concerned with the coordination of aeronautic interests throughout the country, and are active in arranging lectures, conferences, discussions, study visits, etc. These are the Swedish Association of Engineers and Architects (Svenska Teknologföreningen); the Society for Naval Architecture and Aeronautics; and thirdly, the Swedish Society of Aeronautics. Swedish research work is described in several series of reports, published in English and appearing as F.F.A. Reports and Technical Notes, Transactions of K.T.H., and SAAB Technical Notes; additionally there is a large number of technical notes prepared by the various factories and institutions which, for security reasons, are for internal use only.

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From this summary review it will have become evident to the reader that the total number of factories and research establishments now working to provide Sweden with as modern an Air Force as the country's resources allow, is not large. However, everyone within these organizations is working as part of a team and, in turn, the organizations themselves work together in excellent cooperation to provide the Royal Swedish Air Force with the striking power which it requires. Because of the country's limited resources each prototype must be a complete success, and the importance of the "team spirit" cannot be overestimated.

N.A.T.O.

After the Paris Conference

Towards a Military Reinforcement of N.A.T.O.?

By ***

By welding together again an alliance threatened by disintegration, President Eisenhower has scored one of the greatest successes of his career. Despite the mood of confusion and fear in which it had opened, the great Western Conference closed in an atmosphere of unity and confidence. The fifteen nations had realized that this was an inappropriate moment to present their adversaries with a spectacle of disunity and doubt.

Although little has become known of the purely military discussions held at the Palais de Chaillot, it is not too difficult to picture what the North Atlantic Treaty Organization's air strategy will be in the near future.

Overall strategy

It must first and foremost be stressed that the West's overall air strategy, still essentially defensive, continues to be based on the theory of the atomic deterrent and massive counter-attack. As President Eisenhower solemnly declared, the United States would immediately come to the aid, "with all appropriate force", of any N.A.T.O. country which became the victim of an armed aggression. "All appropriate force" doubtless implies the use of the thermonuclear explosive delivered by missiles or aircraft.

However, the possibility of minor frontier incidents or small-scale attacks by one of the U.S.S.R.'s satellites (for example, by Bulgaria on Greece or Turkey) now obliges N.A.T.O. to develop a new strategy, to permit retaliation without necessarily unleashing total war. It is certain that the fact of having nothing in their hands but the "big stick" has been a severe handicap to the Americans since 1945. Strangely (and disappointingly) enough, they have never been able to translate their military superiority into political advantage, even when this superiority was complete. Today they realize that a variety of arms systems is needed, each suited to one particular kind of armed conflict.

This is why General Norstad has rejected Basil Liddell Hart's contention that the ground shield is of no value and that it is enough to leave a "symbolic cordon of troops" in front of the Iron Curtain. Norstad still places the greatest value on the thirty divisions, with nuclear arms, which is the minimum considered essential in Central Europe. When the West German forces come into being—unfortunately a slow process apparently—the first line of defence can be pushed as far to the east as possible. Such a concept entails the use of a specialized support air force, capable of holding out under the terrible conditions of modern warfare. It is already known that General Norstad favours the light strike fighter for this task, since it would be capable of using unprepared fields and, above all, of changing fields almost every day, and thus escaping enemy bombing. This concept is strongly attacked in certain circles, who consider it wishful thinking to believe that a modern fighter, however light, can be moved about like a Nieuport or a Spad of World War I. Present-day aircraft, of whatever category, can be operated only with the support of a complex organization responsible for refuelling and rearming, urgent repairs, checking of equipment, etc., an organization which can be installed only at an air base. What would be the use of moving the aircraft if the whole base cannot be transferred and hence can easily be destroyed by the enemy?

However that may be, the light strike fighter is still for the moment listed among the weapons which N.A.T.O. countries should possess. Unfortunately, whatever the result of the Brétigny contest, the jury will merely be able to "recommend" member countries to buy the winning aircraft. If the United States, as leader of the coalition, does not take over, through some kind of financial device, at least a major portion of the cost of building the aircraft, it is doubtful whether many countries will buy it. This is one of the problems which are rarely solved in coalitions.

The U.S. Air Force's Douglas *Thor* I.R.B.M. (for ranges of around 1,300 nautical miles) during a successful test launching. This missile is now going into production.

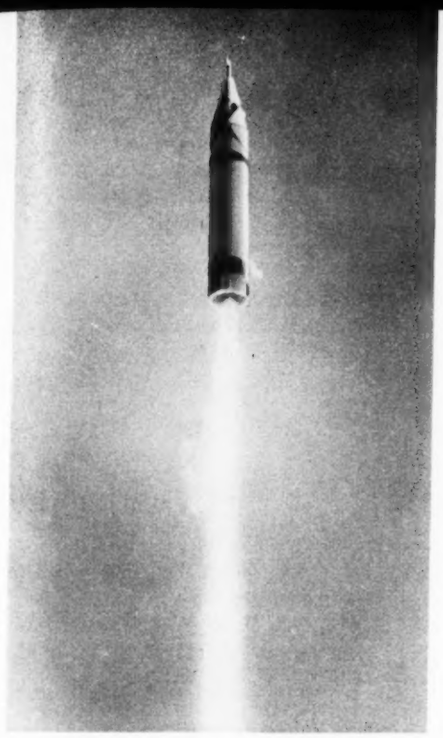
Apart from discussing the organization of the "shield", N.A.T.O. took the far-reaching decision during the Conference not to restrict its activities to the purely European domain. Since enemy action can take place at any point, the Western alliance must also be able to intervene at any point, at any rate whenever it considers an incident of sufficient importance. Hence, from the military point of view, the accent on the formation of a mobile force transportable by air and capable of acting almost instantaneously to extinguish a brush fire before it can spread into a general conflagration.

However, it was in the field of overall strategy that the most serious decisions were made. Although the main concern is now to organize a counter-attack force of missiles, important, strictly defensive measures were also discussed.

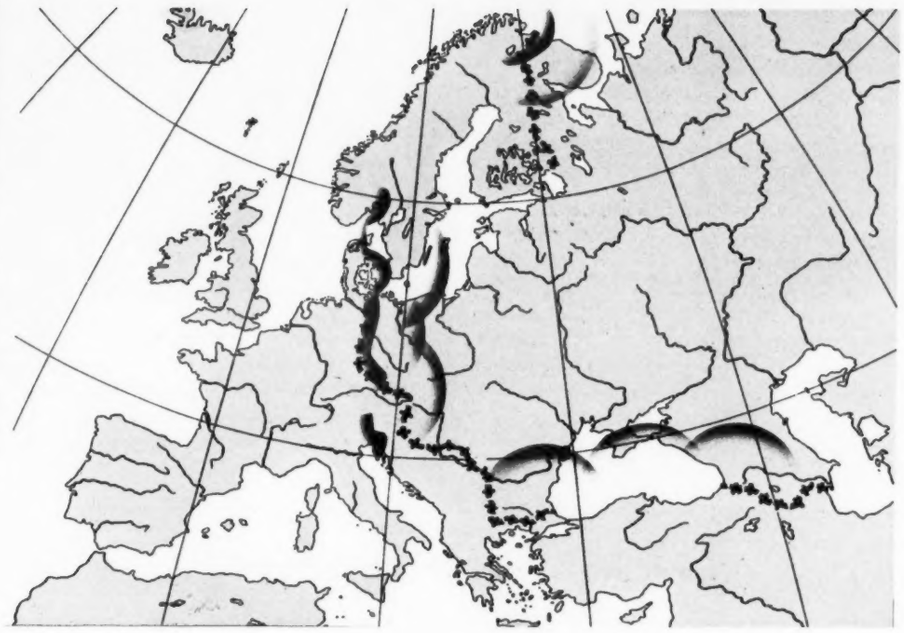
Defence measures

In the matter of defensive measures it was decided that construction of the early warning radar line should be speeded up as far as possible. In principle, this line should already be operational, but various difficulties, due to the slowness and the unwieldiness of the N.A.T.O. system (preparation of specifications, invitations for tenders from all countries, contests, selection of prototypes, preparation of contracts, construction of sites and production of equipment), have caused considerable delays in some areas. At the moment, early warning is provided by non-specialized anti-aircraft radar of relatively short range.

It may be that the placing in operation of the Russian I.C.B.M. will lead to the Americans installing in Europe as soon as possible a certain number of their revolutionary new ORDIR (omnirange digital radar) systems, whose range is said to exceed 2,500 miles. This would enable them to detect Russian intercontinental missiles (launched for example from the Kola peninsula) from the beginning of their trajectory and to track the first half of this trajectory which cannot be detected in the United States. Consequently they could on the one hand discover exactly where the missiles are launched, and on the other transmit



The *Jupiter* I.R.B.M., a rival to the *Thor*, was developed by the U.S. Army's Ballistic Missile Agency and is also to go into quantity production (by Chrysler).



The air defence of Western Europe against manned aircraft: Map shows the range of the early warning radar line to be erected along the Iron Curtain (maximum roughly 240 nautical miles against aircraft flying at medium and high altitude), also the protective range of long-range surface-to-air missiles, e. g., *Nike Hercules*, set up along a line from Oslo to Trieste.

automatically to the United States information enabling tomorrow's anti-missile missiles to be launched earlier and more accurately.

The second defensive measure consists in speeding up the delivery of surface-to-air missile units to Europe. General Norstad considers that during the next few years, when Russia would continue to rely chiefly on manned bombers to deliver atomic bombs on Europe, a combination of surface-to-air missiles and high-performance fighters would be perfectly capable of inflicting losses which some theorists estimate as high as 80%, at any rate on the initial attackers.

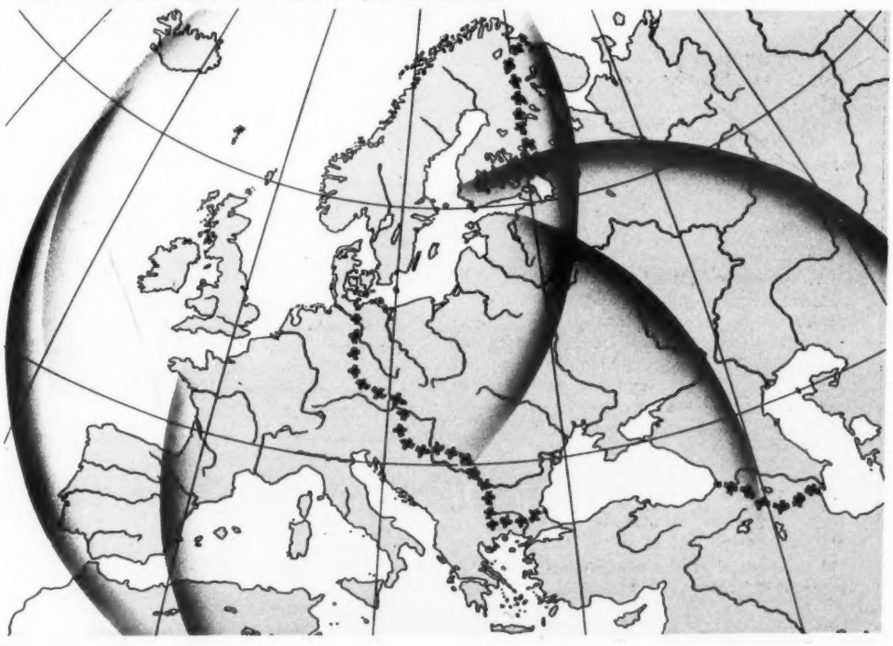
Nike Hercules missiles, whose performance is very much higher than that of the *Nike Ajax*, could take heavy toll of any aggressor, if deployed in adequate numbers near the Iron Curtain to form a first-line barrage. They climb much higher than any known bomber and can attack with nuclear warheads at distances estimated at more than 45 miles. If, for example, a barrage of 1,500 *Nike Hercules* were installed between Denmark and Trieste, the toll which would be demanded of the enemy would be in the region of five hundred bombers! Behind this first line, the main targets would also be protected by belts of missiles. Finally, still further to the rear, the new air defence fighters, directed by ground radar, would concentrate on the remaining bombers which had escaped the barrage, harassing the enemy ceaselessly, even on his way home.

However, the fact must not be ignored that a number of difficulties must be solved before such a plan could be put into operation. By far the most important of these is the 100 percent identification of the enemy. At the very beginning of a war, before N.A.T.O.'s counter-offensive aircraft had taken off, there would be no great difficulty, since anything coming from the east would be hostile. But later on, the air situation above the continent would be chaotic, with bombers, fighters and reconnaissance aircraft of both sides hopelessly intermingled. Though a piloted aircraft—at any rate when flying with good visibility—can identify the aircraft it attacks, the *Nike* cannot! And it is obviously of the utmost importance that the West should not shoot down its own B-52s en route for Magnitogorsk or Baku. The introduction of a fully reliable identification system has thus become a first priority requirement.

The third measure envisaged by N.A.T.O. is concerned with the actual organization of air defence. Certain statements by General Norstad indeed suggest that we are at last on the eve of a real unification of the air defences under a truly inter-Allied command.

Such a reform is highly desirable. Up to the present national air defence systems, using varying equipment and increasingly differing methods, have never been able to arrive at an adequate overall degree of efficiency. The many praiseworthy efforts which have been made in this direction have been doomed to failure because of lack of coherence and often, unfortunately, of inter-

Radius of N.A.T.O. and East European medium-range rockets: While the West's I.R.B.M.'s fired from bases in Britain, Italy, Turkey and other N.A.T.O. countries could cover the major part of European Russia, Soviet I.R.B.M.'s launched from the satellite countries could reach from Iceland over the eastern North Atlantic to North Africa. The radius of action of both sides' I.R.B.M.'s is taken as 1,300 nautical miles.



Allied spirit. One example occurred during an exercise when the umpires asked a large "forward" unit why information on detected enemy runways had not been passed back to the rear air defences: "Why should we?" was the reply, "They will never have any information to pass to us, since all the raids come from our side!"

The air defence system could be unified in two ways, either by creating inter-Allied zones cutting the whole of Europe into parallel east-west strips, without regard for national frontiers, or by placing the existing national air defence systems under a single inter-Allied command. But integration requires that the members of the alliance should surrender some of their sovereignty. It would appear that the last N.A.T.O. meeting at least took active steps in this direction.

The organization of the air forces

It is also probable that the military technicians in Paris discussed the problem of reorganizing the Allied air forces in the various theatres. At present, apart from the strategic counter-attack forces directly under the control of SACEUR, the air units are grouped into Allied Tactical Air Forces and are responsible for air defence missions, support of the ground forces, counter-attack on the tactical level and protection of the strategic forces. They are the successors to the Tactical Air Forces of World War II which were designed to cope with the war of movement between D Day and VE Day, but are entirely unsuitable for any kind of warfare which can be expected today. In a theatre of operations such as Central Europe, for example, there are two Tactical Air Forces, one in the north and the other in the south. This geographical distribution, which is useful only in support of the two army groups, north and south, splits in two the defence forces, the tactical counter-attack forces and the forces destined to support the strategic units. For all these missions it would be more sensible to organize units into separate forces, each under a single commander. Otherwise there will be waste and inefficiency. Within each theatre the air forces should be organized on a *functional*, and not a *geographical* basis, with three commands: defence forces, attack forces and support forces. Only the last-mentioned should be deployed in the same manner as the army groups.

Such a reform, against which in theory there can be little argument, would probably come up once more against the nationalism and insularity of certain countries. Yet it should be put into effect as a matter of urgency, if piloted combat aircraft are to achieve normal efficiency during the last few years of their lives.

Counter-attack measures

The subject which aroused the liveliest discussion and led to the most spectacular decisions was that of counter-attack measures. Though only a relative one, the lead taken by the Russians in the field of intercontinental missiles has caused the Americans to propose the supply of intermediate range ballistic missiles to the European countries. The best-known prototypes of such weapons are the U.S. Army's *Jupiter*, the U.S. Air Force's *Thor* and the U.S. Navy's *Polaris*. According to some reports, the Europeans would get *Thors*. The following is a brief resumé of the non-classified details of these missiles.

The *Jupiter*, built by Chrysler, is a single-stage ballistic missile powered by a Rocketdyne S3 rocket motor of 160,000 lb. thrust with liquid oxygen and kerosene as propellants. With a length of approx. 65 ft. and a weight of around 45 tons, the *Jupiter* is said to carry a 1-ton atomic warhead over a distance of 1,500 miles with an accuracy which was reported last August to be in the region of 400 yards. On this occasion re-entry speed is said to have been 12,000 m.p.h., and the nose cone, which was recovered and which President Eisenhower proudly showed to American television audiences, stood up well to the heat—a remarkable performance since, despite what certain commentators have stated, the difficulties of re-entry had to be overcome, as the *Jupiter* climbs to an altitude of 400 miles.

The *Thor* is made by Douglas and has approximately the same physical characteristics as the *Jupiter* and the same powerplant. It differs mainly in its navigation system, which is a dual system consisting of a main inertial navigation system plus a secondary system of radio navigation. After a difficult beginning, the *Thor* appears to have solved all its problems; on October 4th last it exceeded a range of 2,000 miles. Its last test, a successful one, was made on December 19th.

Latest I.C.B.M. test stand at the U.S.A.F.'s missile proving ground in the Mojave Desert, California. The giant rig erected on a concrete platform can—as shown in the picture—take a complete *Atlas* missile and is used for testing the biggest American rocket motors.

Comment, Friendly and Unfriendly, on N.A.T.O.

"*Time*", December 30th, 1957: "... The U.S. was prepared to make available to U. S. General Lauris Norstad, N.A.T.O.'s Supreme Allied Commander Europe, a stock of intermediate range ballistic missiles ...

"The U.S. had expected some N.A.T.O. allies to reject the offer—notably Norway and Denmark, who have steadfastly refused to have U. S. bombers based on their soil. Norway's Einar Gerhardsen ... said: "We have no plans in Norway to let atomic stockpiles be established on Norwegian territory, or to construct launching sites for intermediate range ballistic missiles." What was not expected was his next statement. Seizing on the fact that the U. S. does not yet have any operational I.R.B.M.'s to give N.A.T.O., Gerhardsen declared: "It is our view that the right course could be to postpone the decision. The time which will in any case elapse before any existing (missile) plans can be implemented could be used to examine the possibilities for renewed negotiations with the Soviet Union on disarmament."

"Denmark's Hans Christian Hansen ... echoed the Norwegian line."

*

A. A. Gromyko, Soviet Foreign Minister in a message to the Supreme Soviet on December 21st, 1957: "... In the event of a war being unleashed, devastating retaliatory blows will be struck both at countries on whose territories the N.A.T.O. war bases are situated, and at countries which are setting up these bases for aggressive purposes. Nowadays there is no place in the world where the aggressor could escape just punishment.

"This is why we cannot fail to welcome the sober statements made by the Prime Minister of Norway, Mr. Gerhardsen, and the Prime Minister of Denmark, Mr. Hansen, who, conscious of the national interests of their countries, refused to open the territories of their countries for the deployment of rocket and nuclear weapons. We cannot but point to the grim consequences which may be entailed by the consent of the governments of some European states to the setting up of atomic bases and rocket ramps in their territories.

"We are somewhat surprised by the bellicosity of the Italian and Turkish statesmen. They come out in favour of atomic and hydrogen weapons, in favour of rocket bases being set up on the territories of their countries. This is hard to understand. Italy's geographical position is such that she cannot in fact use ballistic or other rockets without violating the neutrality of countries which separate Italy from the Soviet Union."

*

Federal Chancellor Adenauer in a statement to the press on December 19th, 1957: "The Conference went off admirably: I am very satisfied and hope that we can now get down to work for our peoples and for the peace of the world ..." The Atlantic pact, the Chancellor continued, had developed during the past few years into a real community.

*

Raymond Cartier, in the French weekly "Match" of December 28th, 1957: "... N.A.T.O. has never been more than an official affair, cold and boring as the speeches during formal visits. This is why it is going through a crisis, at the moment when it is more indispensable than ever.

"One of the branches of the star shows a large planisphere covering a whole panel. The U.S.S.R. is coloured red; the satellites pink, N.A.T.O. blue; the neutrals (such as Switzerland and Sweden) are green. The English have made a play on words out of this. "Such and such a country", they say, "is turning green."

"One of the countries which has most frequently been described as turning green is France, who John Foster Dulles thought was about to leave N.A.T.O. He was shocked to find that Germany was turning even greener, as he was to discover during a somewhat painful talk with Adenauer."

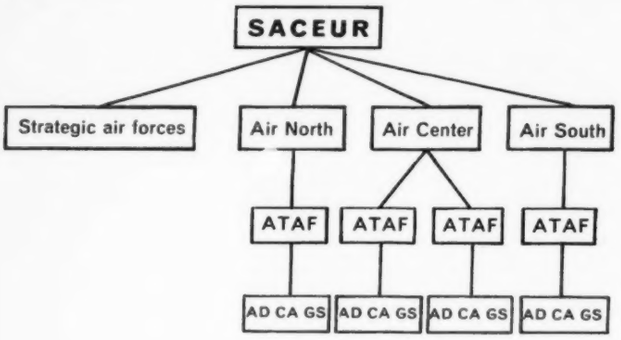
*

Joseph Alsop in the "New York Herald Tribune" of December 26th, 1957 (and in "Figaro" of December 27th, 1957), claimed that the Conference had "only plastered over the cracks in the facade ..."

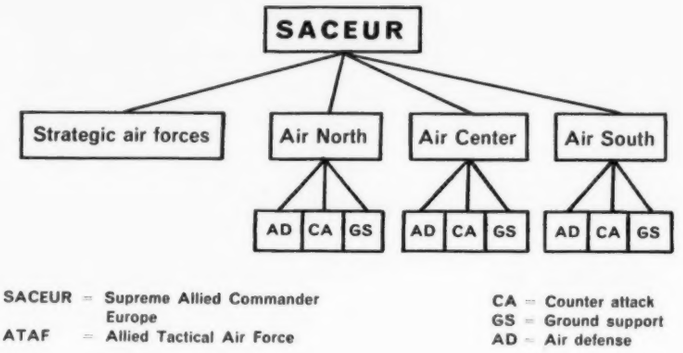
"... In sum, the N.A.T.O. meeting has shown the classic symptoms that are always produced by a dangerous tilt in the power balance. These are, first, a loosening of alliances on the side that has been weakened; second, a tendency to seek interminable parleys with the side that has grown stronger, in the febrile hope that the strong will not insist upon the logic of their strength.

"The free nations showed these symptoms when Hitler upset the European power balance in the '30s ..."

N.A.T.O.



Present organization of N.A.T.O.'s air forces



Projected organization of N.A.T.O.'s air forces

SACEUR = Supreme Allied Commander Europe
ATAF = Allied Tactical Air Force
CA = Counter attack
GS = Ground support
AD = Air defense

SACEUR = Supreme Allied Commander Europe; ATAF = Allied Tactical Air Force; AD = air defence forces; CA = tactical counter-attack forces; GS = ground support forces.

The main features of the *Polaris*, which is manufactured by Lockheed for the Navy and is designed especially for use aboard submarines, are its squat form, its solid-propellant Aerojet power unit, its lower weight (the warhead is said to weigh no more than 1,000 lb.) and its General Electric inertial navigation system.

It may be asked why the Americans should be so anxious to install I.R.B.M.s in Europe when they have stated officially, in particular through General Norstad, that the Russian lead in the I.C.B.M. field does not alter the balance of forces, since S.A.C. is still capable of inflicting fatal damage on the U.S.S.R. however efficient its air defences may be.

The reason is very simple. The basic problem is that of a surprise attack. It will be some time before ORDIR type long-range radar for the detection of missiles can be put into service, and the Russians may have I.C.B.M.s in quantity before that time. There will therefore be a period when the U.S.S.R., through a massive missile attack (which would be undetectable in time), could theoretically destroy all the American counter-attack forces*, either on their metropolitan bases, or overseas, in England, Spain, Morocco, Libya, Arabia, Japan. The strategy of massive nuclear counter-attack, which is still the basis of the West's military policy, would thus break down.

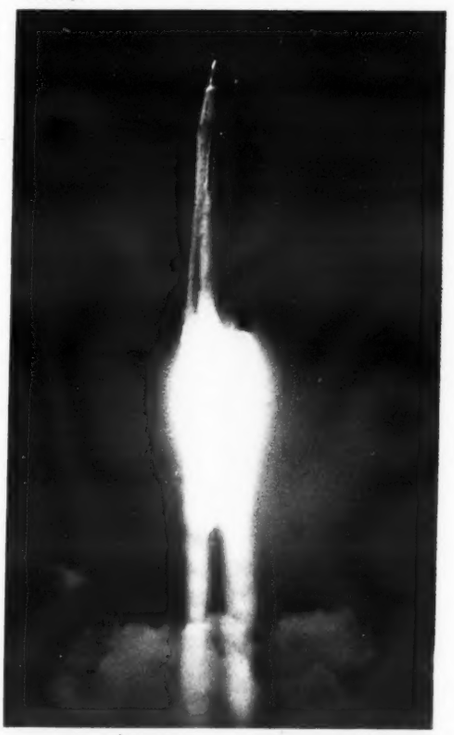
The moment both sides have missiles of sufficient range, any hope of a lightning victory vanishes, as missiles, which in any case are point targets, can be camouflaged, protected, dispersed and even in some cases mounted on invulnerable mobile ramps so that the great majority will escape the first attack. Even if this attack wipes out cities, ports, bridges—in a word all organized life in the country attacked—it will not prevent the reprisal missiles from setting off within a few minutes to inflict the same sort of damage on the aggressor, whatever precautions he may take.

The missile age thus introduces a complete "nuclear stalemate", thereby reducing the risk of total atomic war.

To achieve this situation, of course, the West must have appropriate reprisal missiles, and this is why, as long as the United States has no I.C.B.M.s, it is essential that I.R.B.M.s, suitably deployed, should take over their tasks.

From the purely military point of view it is difficult to understand the reluctance of certain N.A.T.O. countries to accept the United States offer. The presence of I.R.B.M.s on N.A.T.O. territory is not substantially more "dangerous" than that of bases for nuclear bombers or land forces armed with tactical nuclear missiles. Any country which accepts American aircraft carriers with A-bomb aircraft in its ports runs the same "danger" as if it accepts *Thors* or *Jupiters*. On the contrary, the European nations are at present entirely without defences of their own against any massive attack by Russian forces. Admittedly such an attack, though capable of destroying almost all of Continental Europe, would not end the war, and it is quite possible that ultimately the few survivors would find themselves on the winning side. But how many survivors would there be? In future these nations too will be able to retaliate. Though still not capable of preventing their own destruction, they would be in a position to destroy an aggressor, who would thus think twice before attacking. All this, of course, is based on the hypothesis that the I.R.B.M.'s are placed entirely at the disposal of the European countries, without reservations. But this takes us outside our chosen, purely military field.

Convair *Atlas* intercontinental ballistic missile, which made its first successful test launching, with reduced range, in mid-December 1957. It is hoped that the full range of more than 4,000 nautical miles will be reached shortly.



But if, as has been written, the plan is to set up what has been described as a "double veto" system, with the host nation being in sovereign control of the launching sites, and the United States of the atomic warheads, the least that can be said is that the outcome will be very disappointing. The time factor, which always acts in favour of single commands and against coalitions, is more important here than ever. The suggestion of sharing sites and warheads, with certain complete systems belonging to the host country, and others to the United States, as may reportedly be done in Britain, would be slightly better. But the ideal would be to have no sharing at all and that the political harmony between the Allies should be such that there could never be any hesitation about the use of I.R.B.M.s.

*

Finally, however much uncertainty there may be about the military decisions taken at the recent Conference, it may be said that under the whiplash of the Russian I.C.B.M. and Sputniks, the Western alliance, which was slumbering and even threatening to break down, has at least temporarily pulled itself together and appears determined to progress from a state of lethargy—and sometimes of virtual anarchy—to one of efficiency.

It is to be hoped that this goodwill will quickly be translated into acts and in particular into preparation for war in the air which, now more than ever, is the key to the future. The announcement of the launching of an American satellite or a successful test firing of an *Atlas* over a range of 5,000 miles must not be allowed to lull N.A.T.O., so recently awakened, back to sleep. *Caveant consules!*

* Apart from the S.A.C. aircraft which are constantly in the air. But this "flying guard" would probably not be sufficiently large to knock out the enemy.

The Manned Bomber gets a New Lease of Life

by Pierre M. GALLOIS, Paris

Several billions of dollars have just been earmarked for the development and manufacture of piloted bombers to replace Strategic Air Command's Boeing B-52s around 1966 or later. It would appear that the overall programme under which the WS-110A weapons system has been planned is aiming at speeds in the region of Mach 3 — at any rate over a certain portion of the route — a radius of action of 5,000 miles and the capacity to carry between 3 and 4 tons of explosive. Near the target, altitude could be in the neighbourhood of 82,000 ft. The powerplant is said to consist of General Electric J93s specially designed for high altitudes and using so-called "chemical" fuels. As it is to come into service when long- and medium-range offensive and defensive missiles will have proved their value, the WS-110A has been designed to protect itself from their attention. Its vulnerability in flight will be reduced by its speed and by the anti-missile devices it will carry. Vulnerability on the ground, in the event of a surprise attack by long-range offensive missiles, will probably be countered by "permanent mobility". Training flights in an aircraft such as will emerge from the WS-110A project will have to be extended sufficiently to ensure that a substantial portion of the air reprisal force is constantly in the air. No more obvious solution could be found: the problem of vulnerability on the ground is solved by keeping in the air a number of aircraft whose combined power of destruction would exceed the aggressor's absorption capability. If this radical solution has been chosen for the WS-110A, it will doubtless have enabled North American's engineers to give priority, in designing their aircraft, to the requirements of cruising flight at high speeds and high altitudes and to devote only secondary attention to the question of take-off from small fields. Obviously, if the reprisal force is to be protected by being constantly in flight, dispersion on the ground, with bombers being distributed among as many airfields as possible, is no longer imperative. Hence, for the new aircraft, the present trend in favour of the shortest possible runways can be reversed. Also, it should not be forgotten that this class of aircraft is not really designed for protracted operations performed from airfields varying with the combat theatre. The WS-110A's task is to "survive" a surprise attack by aircraft and missiles, get through the enemy's defence system thanks to its "power of penetration" and strike. If it were ever used, it would probably not be required to carry out more than a single attack; if this were not successful, it would probably not be possible to launch a second.

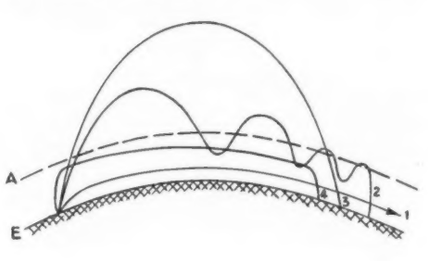
Crews needed for another twenty years

Beyond the WS-110A, a new programme is said to be circulating in the design offices of America's major aircraft manufacturers Reportedly it calls for another manned vehicle, this time reaching a speed of Mach 5 and probably using a composite powerplant consisting of ramjets and straight jets both operating throughout the speed range covered by the aircraft. The WS-110A and its successor would thus "co-exist" with offensive missiles at least during the next twenty years. To carry through such programmes to their normal conclusion will cost billions of dollars. The U.S. Secretary of Defense has not agreed to them without good reason. General Twining, long the Chief of Staff of the U.S. Air Force and today Chairman of the Joint Chiefs of Staff, has never concealed the interest he takes in piloted bombers.

This is no sentimental attachment to a proven formula on which the United States Government, since Hiroshima, has based its security and that of its Allies. The further the development of ballistic missiles progresses and the efficiency of existing — and even foreseeable — defence systems decreases, the more important the role of a reprisal force becomes. Strategic Air Command's mission has been described in an earlier issue[1] as "to safeguard peace by deterring a potential aggressor through the threat of atomic reprisals which could be carried out at any time and at any point of the globe; in the event of war to destroy the enemy's air power (phase 1) and the enemy's war potential (phase 2)."

[1] "Sword, Shield... and a Mailed Fist," *Interavia*, No. 11, 1957.

Diagram of the trajectories of manned long-range bombers and intercontinental ballistic missiles. E = earth's surface; A = outer limit of the atmosphere; 1 = manned long-range bomber; 2 = skip missile; 3 = ballistic missile; 4 = glide missile.



General Twining and the chiefs of S.A.C. doubtless consider that in the present stage of development the manned bomber is the best instrument for this mission. It seems to be admitted across the Atlantic that intermediate range and intercontinental ballistic missiles may take over some of the missions today performed solely by piloted aircraft. But at the same time it would seem that the missile will not entirely replace the aircraft, at any rate within the next fifteen to twenty years.

A similar situation reportedly exists in the Soviet Union, where the design and production of manned bombers is continuing and where efforts are apparently being made to increase the number of Mach 0.8 to 0.9 offensive aircraft, while designers are at the same time working on supersonic bombers and ballistic missiles. This suggests that ballistic missiles are regarded as weapons that can be immediately exploited on the political level, while in the military field the old techniques are developed further and future utilization of the new techniques is being prepared. The Russian daily "Krasnaya Zvezda" recently published an article on the flight tests of a new heavy bomber which had just set up a distance record without in-flight refuelling. Some Western experts think that this is perhaps an improved version of the four-turboprop Tupolev *Bear*. Thus on both sides of the Iron Curtain production and further development of piloted offensive aircraft continue.

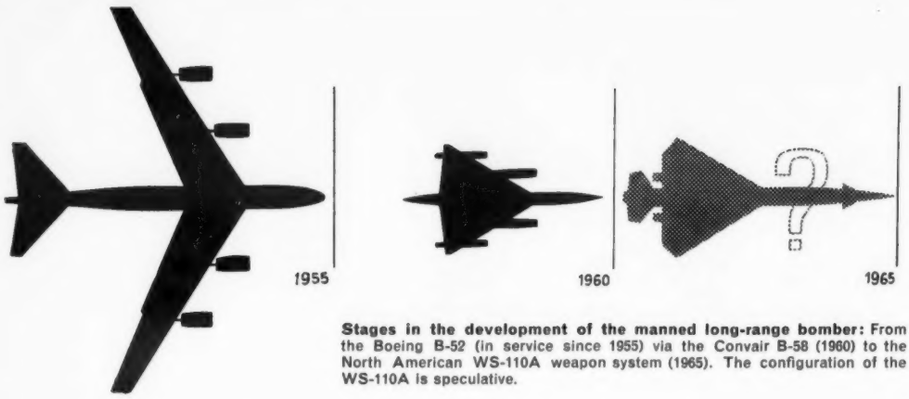
Why this precaution?

Complexity, precision, risk

Firstly, no doubt, because missiles are still in the experimental stage. Nobody denies that, after extensive tests, large-scale production of long- and medium-range offensive missiles, with clearly defined operational qualities, will be perfectly possible. But it will take time to build up an adequate arsenal of these weapons.

The "complexity" of missiles has also been stressed repeatedly and illustrated by the classic calculation which computed the probable reliability of a missile with 5,000 components each having a reliability of less than 100 per cent. The same of course applies to the piloted aircraft, at least as far as the actual machine is concerned. But, apart from the fact that long experience has been gathered in this field, the human pilot can make good for local defects which would be irremediable without his presence aboard.

Opinions are divided on the military use of ballistic missiles, because of their question-



Stages in the development of the manned long-range bomber: From the Boeing B-52 (in service since 1955) via the Convair B-58 (1960) to the North American WS-110A weapon system (1965). The configuration of the WS-110A is speculative.

able accuracy. When the Soviet Government announced last August that it had successfully tested an I.C.B.M., the spokesman alluded to a precision of between 6 and 10 miles. Let us suppose that in the present phase, when first stocks of missiles are being built up, the average error is in the region of 0.5 per cent of the range. An I.R.B.M. falling 1,500 miles from its launching ramp might hit a point some 8 miles from its target. If the future I.C.B.M.s had the same degree of inaccuracy, they would fall 25 miles from the centre of their target, assuming the latter to be 5,000 miles distant. Of course, these are excellent results compared with those achieved with long-range artillery.

The launching of missiles across oceans and continents raises difficult problems as regards precision. The initial azimuth angle imparted must be accurate to within one fifteenth of a degree. Propulsion thrust and speed of the missile before the beginning of the pure ballistic trajectory must also be extremely accurate, and tolerances of the order of 0.1 percent of the speed may not be exceeded. For a missile with a range of 5,000 miles, for example, this speed must be in the region of 20,000 ft./sec. Allowance must also be made for the earth's rotation, whose speed vector is not parallel to the missile's point of launch or impact, and corrections must be made for the Coriolis effect. Finally, the exact geographical coordinates of the target must be known. The latter are more difficult to verify than might appear. The inaccuracy of mapping information is notorious, and here the advantage certainly lies on the Soviet side, because of the hermetic sealing off of the eastern territories. The accumulation of errors inherent in the missile and the cartographical errors may mean that the number of missiles necessary to obtain a given amount of destruction becomes prohibitive. Here it is interesting to recall what Strategic Air Command spokesmen have said of their piloted bombers: "If celestial navigation is combined with radar the navigation error is practically zero."

It will be argued that the use of nuclear explosives modifies the degree of accuracy required. This is true when the target to be attacked is of large dimensions. It is even more true if the aim is not total destruction. A thermonuclear warhead of several megatons — weighing around two tons — and exploding at altitude could have "adequate" thermal effects over several tens of miles from the vertical at the point of detonation. This would be a terrible threat if wielded against a large city. Even if uncertainty persists as regards the carrier vehicle's degree of accuracy and the number of missiles which would have to be launched to ensure that the city would probably be hit, the mere existence of such a possibility suffices to give the missile decisive political importance. Popular reactions ignore technical details, and even a vague threat takes on concrete proportions in public thinking. Public opinion is not interested in discussion of the potential accuracy of these missiles or in any arguments stressing their limitations but tending to overlook their destructive power.

However, a would-be aggressor would have to possess heavy megaton projectiles plus the corresponding carrier vehicle and, in the political domain, accept the incommensurate risk of basing its security on a threat directed solely against its adversary's major cities. Even Strategic Air Command has been instructed to give first priority to attacks on the enemy's air potential. When it comes to deterring an aggressor through the threat of terrible reprisals, it is sufficient for the nuclear sword of Damocles to be suspended above his cities to encourage him to negotiate. This is the advantage of a purely defensive coalition. Provided it fully appreciates the laws of the aero-nuclear age, it can prevent recourse to force with a much smaller arsenal of weapons than that which any would-be aggressor must possess. The latter would first have to devote a considerable number of missiles to neutralizing his victim's reprisal forces, an operation which might well be terribly costly.

From the unmanned to the manned supersonic missile: Instead of the cancelled SM-64 *Navaho* ramjet guided missile (picture), North American is to develop the WS-110A weapon system (with General Electric J93 jets using high energy fuels).

In the present stage of development, it is difficult to see how Strategic Air Command's task of destroying the enemy's aeronuclear resources could be performed solely by ballistic missiles. And if, on the other side, the Russian military based their strategy for destroying their adversary's reprisal forces on the use of ballistic missiles of various ranges, it is equally difficult to see how this operation could succeed.

Missile launching sites will be of relatively small dimensions, especially in relation to the scale of missile exchanges envisaged. They can also be protected, either by using natural cover in mountainous country, or by partially or fully burying them underground and using concrete to reduce their vulnerability. If the degree of accuracy of the ballistic missiles used is in the order of 0.5 percent of their range, and if the ground burst of a megaton warhead is considered necessary to be sure of destroying a protected launching site, the aggressor will have to use a considerable number of missiles. Theoretically, to be certain of success, it would take roughly twenty missiles to destroy *one* launching site at a range of 900 miles, 80 if the range is 1,800 miles, 140 if it is 3,000 miles and nearly 200 if it is 5,000 miles.

An alternative would be to rely solely on the blast and heat effects produced by an air burst at, say, 6,500 ft. altitude. In this case, the above figures could be divided by about six. But if the consumption of missiles is substantially reduced, there is no longer any certainty of destroying the target, particularly if it is underground or well protected. It is obvious that, under these conditions, it would be virtually impossible to achieve the simultaneous destruction of all reprisal forces—the prime requisite for the success of an aggressive action—if the launching sites to be neutralized were at all numerous.

A simultaneous attack by aircraft carrying nuclear bombs would scarcely be easier to organize, but at least the number of projectiles required would be much smaller, even against a virtual point target such as a ballistic missile launching platform. Use of piloted aircraft under these conditions is thus by no means inconceivable.

The whole of the foregoing applies only to static targets, such as cities, missile-launching sites, stores depots, etc... Before mobile targets can be destroyed they must first be identified, either visually or by means of instruments. When such reconnaissance is required, it is logical to use the same vehicle to attack the target which it has identified.

Nobody denies the *political* power of ballistic missiles. Their military value, however, is disputable, at any rate at the moment. It may be argued that if the popular conception of missiles is sufficient to modify the international situation, then their efficiency is proven. This is true only temporarily, as long as the limitations of these weapons are less known than their advantages. For this reason the WS-110A will probably enjoy a long career. In the new arsenal with which the "Biggest Two" are providing themselves, this aircraft and its counterparts will "co-exist" with the "soulless weapons" which are today in their adolescence.

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The picture shows a Gun Fire Control System for 40 m/m Guns

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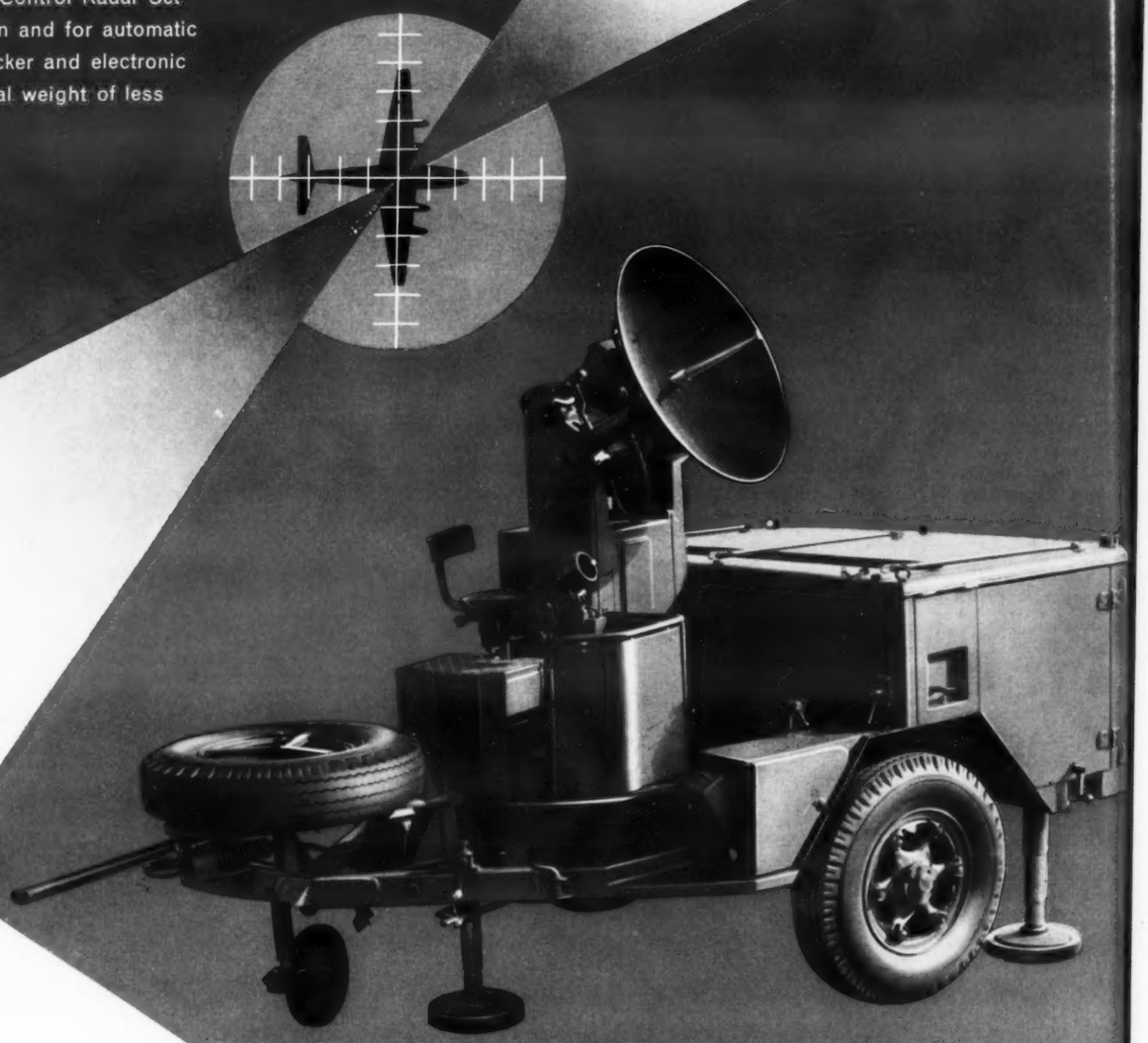

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—Mr. C. I. Orr-Ewing, Under Secretary for Air.

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"The Vulcan comes from a good stable"

In addition to Mr. Orr-Ewing's tribute, the Air Officer Commanding No. 1 Group, Bomber Command, had this to say: "We are extremely pleased with the Vulcan, both from the operating and the maintenance aspects. The way in which this large aircraft and its complex system has been brought into use in the front line of Bomber Command, without any of the enforced groundings so frequently experienced with new types of aircraft, is most gratifying. The Vulcan is giving us splendid utilization; indeed, it is far better than we experienced with any other type of aircraft, large or small. The Vulcan comes from a good stable and is liked by the servicing crews as well as the flying crews."

We are proud of our stable—from it have come: *the Avro '504'—the first long-range bomber of World War I; the faithful Anson; the immortal Lancaster, used by the Dam Busters in World War 2; and now the Vulcan.*

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The V-Force

By Derek H. Wood, Interavia's London Editor

Avro *Vulcan B.1* "V" bombers in their new version (with double bent wing leading edge).

In the Spring of 1955, a new and very potent force came into being in Western Europe when the first R.A.F. Bomber Command *Valiant* Squadron became operational. Until then, the only deterrent air umbrella in the West was Strategic Air Command whose commitments literally round the globe stretched even the mighty resources of the United States to the maximum. *Now with over 100 "V" bombers already in operational service and British atomic and hydrogen bombs tested and available, the situation has radically changed.*

Working in the closest cooperation, S.A.C. and Bomber Command have been able to reassess their target selection programme, and many of the earlier gaps have been filled. In addition, with Bomber Command attending to many west European targets such as tactical bomber bases and short range rocket sites, S.A.C. has been able to add a number of target priorities to its ever-growing list in other spheres.

R.A.F. Bomber Command, as laid down in the White Paper on Defence, is one of the largest single items in the British arms programme. It is, like S.A.C., essentially a mobile force with a string of prepared bases in Europe through the Mediterranean to the Far East, and it is intended that by spreading the squadrons over a wide area, complete with all services, weapons etc., it will be virtually impossible for an enemy to destroy the "V" force in a lightning attack.

The "V" bombers are also for use in "local police actions" where the threat of precision delivery of normal explosives from high altitude could well be a stern deterrent to uprisings. The *Valiant* in a non-nuclear role was, of course, used during the Suez action in 1956.

Despite the advent of the I.R.B.M. and I.C.B.M., the R.A.F. feels that the manned bomber, particularly with long-range stand-off bombs, will continue for many years and that the ballistic missile and the bomber will share the deterrent role through most of the 1960s. As yet, no-one can foresee the complete removal of the bomber from the scene, and indeed the possibility of manned M=3–5 bombers and an antidote to the ballistic missile may mean a complete swing of the pendulum within 10 years back to a machine with a human crew, although by then it may be termed a "manned missile".

The aircraft

The history of the "V" force is virtually the history of the three "V" bombers, *Victor, Vulcan* and *Valiant,* and upon their performance and the quality of their internal equipment has depended the success of the deterrent concept.

At the end of the war the backroom planners attempted to make an assessment of the world situation and estimate when the danger of another conflict might become acute. In the "world at peace" atmosphere of 1945—1946, they accordingly set their sights on 1956, and the air staff in 1946 drew up a requirement for a most advanced and complex aircraft with 100 percent improvement on the performance of the then current bomber, the *Lincoln.* It had to be capable of speeds just under M=1, operate at altitudes of over 50,000 ft., carry five crew, a complete new set of radar, radio and navigational aids, and take atomic bombs or a very heavy load of conventional explosives. In addition, it had to have a range in the 4,000 to 5,000 mile bracket.

Most of the major firms in the industry tendered to this extremely exacting specification with an extraordinary assortment of designs including deltas, straight sweep, tailless flying wings and variations on compound sweep in an attempt to overcome the weight, speed and altitude problems, while keeping landing speeds down and maintaining a high degree of manoeuvrability. The Government of the time decided that, as the whole concept was so radical, two different types of design should be developed to the prototype stage, both to utilize the same crew layout and equipment.

Thus, in November 1947, A. V. Roe were told to go ahead with a type 698 delta now known as the *Vulcan,* with *Olympus,* and Handley Page received instructions to proceed with the HP.80 crescent wing bomber later christened the *Victor,* and powered by *Sapphires.*

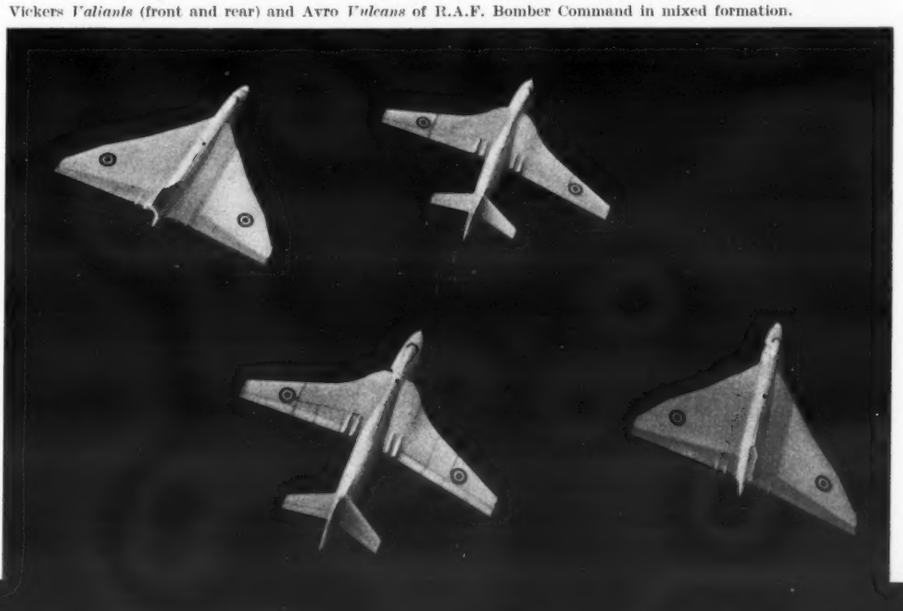
Because of the limited aerodynamic knowledge then available, a tremendous amount of basic research had to be done on both machines. While wind tunnel research cleared up many of the unknowns, one-third scale models were flown in the shape of Avro's 707 series of deltas and the HP.88 which was a Vickers 510 experimental fighter embodying the *Victor* wing and tail unit.

Also in 1946, the Air Ministry issued a specification for an "insurance" aircraft of more orthodox design to be available as quickly as possible, and this materialized as the straight winged Short SA.4 *Sperrin* with four *Avons,* which first flew in 1951, but never went into production. In 1947 further reconsideration by the Air Ministry produced a contract for a second interim type with performance closer to the *Victor* and *Vulcan.* This machine became the *Valiant* which was ordered into production early in 1951.

Vickers completed a remarkable job on the *Valiant,* flying the prototype in May 1951 four years after design had started, and having the type in squadron operational service in the spring of 1955—only four years following the placing of the production order.

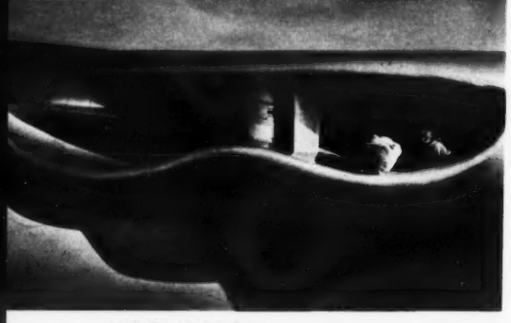
The performance of the *Valiant* exceeded R.A.F. expectations with its speed around M=0.9 and operating altitude around 50,000 ft. Despite the fact that it was intended to be an

Vickers *Valiants* (front and rear) and Avro *Vulcans* of R.A.F. Bomber Command in mixed formation.



Inspecting a *Valiant* before a night operation.

Checking the undercarriage...



... and the air intakes.

Fuelling.

interim type, the *Valiant* is still the mainstay of the "V" force with nine squadrons operating, and it holds the distinction of having dropped atomic bombs during the tests at Maralinga, Australia, and hydrogen bombs while based on Christmas Island.

The first squadrons of the giant delta wing *Vulcan* are now operational, and a number of further squadrons will be formed during 1958. Crews for the crescent winged *Victor* are now being trained at Gaydon in Warwickshire, and a squadron should be operational this summer.

R.A.F. background and training

While the aircraft themselves were proceeding from drawing office to shop floor and from shop floor to flight test, the R.A.F. was engaged in the mammoth task of preparing to receive them.

Many airfields had to be modernized with new runways, reinforced hard-standing, and larger hangars. Complete new electronics repair and maintenance buildings were erected, and hundreds of up-to-date dwelling houses put up for air and ground crew. Every conceivable type of ancillary equipment had to be procured, and even ladders and towing tractors had to be custom-built for the new aircraft.

New ground equipment for ILS, VHF, UHF and long range R.T. was installed, and Bomber Command Air Traffic Control reorganized generally. In-flight refuelling was ordered as standard equipment and Flight Refuelling Ltd. developed new hose and drum units etc. for speedy conversion of a "V" craft from bomber to tanker or vice-versa.

The actual crewing side and the composition of the squadrons called for radical re-thinking. The whole technique was completely different from that of the *Lincolns* and *Washingtons*, the "heavies" which Bomber Command had previously been flying. It was here that experience with the *Canberra* light bomber proved invaluable. While the *Canberra* was in a different class altogether from the "V" bombers it was, and still is, a high performance aircraft at altitudes not far short of the *Valiant*. It provided the jet experience from which crews could be picked for the *Valiants*, and many of the techniques later employed on "V" bombers were tried out on *Canberra* squadrons.

Airborne in a Valiant

East Anglia, as thousands of ex-World War II *Lancaster* and B-17 aircrew know so well, is as flat as the proverbial pancake, and just as in wartime days it is still a veritable forest of service airfields, both British and American.

To one of these stations, at Honington in Suffolk, I was invited to take a long awaited ride aboard a *Valiant* "V" bomber—the first correspondent of an overseas paper to do so. I was anixous to see the changes that come in the wake of re-equipment with "V" bombers, as it was only two years before that I had flown from Honington as a passenger in a *Canberra* on a night exercise over Germany.

Changes there were in plenty, more buildings, more facilities of every kind, and towering above the skyline the silhouettes of 32-ft. high *Valiants* at dispersal. No medical tests were required there as I had already spent half a day in London at the Central Medical School being looked at through a microscope to see if I would expire should pressurization fail at altitude.

Early on a very blustery wet morning I foregathered with Squadron Leader Cox and his crew from No. 7 squadron to draw my quota of overalls, Mae West parachute, mask and "bonedome".

I was surprised at how little equipment was needed, having memories of three pairs of socks, a rope vest and umpteen pullovers required for freezing high altitude sorties in *Canberras*. I was soon to discover, however, that normal *Valiant* flying leaves much to be desired in modern airliners, with exceptional quiet, gentle warmth, and cabin pressure at 9,000 ft., even at operating heights around 50,000 ft. Naturally for combat the degree of pressurization is reduced—from 9 lb./sq. in. to 3 lb./sq. in.

A very well equipped air conditioned bus took us out to a late production *Valiant* where the crew chief and his team were waiting for final checks. With an aircraft weighing around 55 tons all-up, and containing 85 electric motors, 225 relays and 38 miles of cabling, the ground servicing, under the crew chief, is absolutely vital.

Squadron Leader Cox and his co-pilot Flying Officer Sherman then proceeded to "do the rounds" which consists of going through an external check list as long as the menu at the Savoy (in fact containing 70 items). Equally stringent checks are carried out in the aircraft before take-off and at other stages in a flight. Initially all these checks were lengthy, but they have now been reduced to a minimum of time by experience and the efforts of No. 5 Bomber Group's travelling standardization unit, which is made up of very experienced officers from each of the "V" aircrew branches.

Inside the *Valiant* the two navigators and the Air Electronics Officer sit side-by-side on comfortable seats facing aft, with a long "work bench" and an impressive array of navigational, bomb aiming and radio gear, including of course Doppler. Stepped up forward are the pilot and co-pilot with full dual controls. For anyone who wishes to lean over the pilot's shoulders a couple of London Underground commutor hanging straps are conveniently provided.

The navigators showed me the emergency drill of jettisoning the side door (which automatically extends a slip stream deflector) and pointed out that the pilots wait until the others are clear before increasing speed to 220 knots, jettisoning the canopy and leaving, by courtesy of Martin Baker.

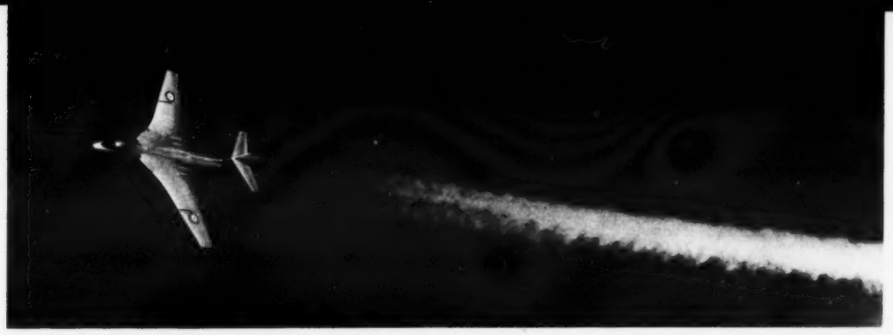
On our sortie we were to fly leisurely up to Scotland and back and then do a practice GCA on the way back. Cleared by the tower, the *Valiant* fairly leaped into the air using only a portion of the 3,000 yard runway, and with undercarriage and flaps up we climbed away to 30,000 ft. at a steady 4,000 ft./min. Speeds were reduced precisely at given points on the climb, and I watched this put in hand while doing some strap hanging.

Effortlessly we reached over 47,000 ft. (cruising at M = 0.75) and took exactly 40 minutes to cover the 308 statute miles to Prestwick, which, however was obscured by cloud far below. It was extremely difficult to realize we were travelling at a ground speed of over

"Only the very best" has been the motto throughout for aircrew choice for the "V" bombers. Basic qualifications for a "V" bomber Captain are "above average" flying ability, at least 1,750 hours as a first pilot, and a completed tour of duty on *Canberras*. A further requirement is that he should have considerable experience of flying four-engined aircraft.

Second pilots must have at least 700 hours as a first pilot in their log books and usually a tour of duty on *Canberras*. A *Canberra* tour is also a *sine qua non* for navigators, and for navigator/bomb aimers a course at the Bomber Command training school at Lindholme. The recently created category of Air Electronics Officers who operate and look after airborne radio and electronic equipment, must also have flown a tour with either Bomber, Transport or Coastal Command. "V" force aircrew remain with their squadrons for five years whereas the normal period for other Commands is 2½ to 3 years.

Some cadets from the R.A.F. Technical College Henlow (Beds.) who successfully complete their course, can volunteer for aircrew duties with the force, and if accepted, must then take a further course at the Air Electronics School, R.A.F. Swanton Morley (Norfolk).



A *Valiant* banking at high altitude.

Comparison in size between the English Electric *Canberra B.6* (left) and the Handley Page *Victor B.1*.

Mere possession of these qualifications does not mean that aircrews automatically undertake training on "V" bombers—the crews are selected and then reviewed throughout the various stages in training.

The Operational Conversion Unit training syllabus is divided into three phases. The first consists of four weeks' ground school during which pilots are instructed on the aircraft performance and systems, with emphasis on flight planning and "cruise control". There are models to demonstrate all the aircraft's systems and such matters as the importance of consuming fuel in such a way as to keep the aircraft within its centre of gravity limits. Second pilots are instructed on their particular responsibilities, which include management of the fuel system in the air, control of the cabin pressurization, and recording engine conditions—power, jet pipe temperatures and so on. Navigators and signallers receive similar instruction covering their duties.

Towards the end of this phase crews are introduced to the electronic flight simulator which reproduces all conditions of flight except G. There are separate simulators for *Valiant, Victor* and *Vulcan,* and an additional one for flight refuelling training.

The second phase of the course consists of two weeks of ground school and actual flying, and the third of six weeks flying. The first instructional flight in the aircraft consists of two hours demonstration of its handling at high altitudes, followed by landings. Then comes a short cross-country flight and demonstration of emergency systems. The first "solo" flight, i.e., the trainee captain flying the aircraft, accompanied by his own second pilot, is made on the third exercise. Altogether the pilots spend over 50 hours flying, of which about half is at night. Initial exercises on the Instrument Landing System are done in *Canberras*.

The future

By the end of this year, Bomber Command will have the *Victor B.1* and *Vulcan B.1* in service in strength, and the *Valiants* will be gradually turning over to flight refuelling tanker duties which will give the "V" force virtually unlimited range.

Beyond this will come the *Vulcan B.2* with 16,500 lb. thrust *Olympus BOl.6,* and the *Victor B.2* with the 17,250 lb. thrust *Conway RCo.11*. Both aircraft will have aerodynamic refinements, longer range and better all-round performance coupled with the ability to carry the Avro rocket-propelled stand-off bomb. This will make them virtually long-range guided

410 knots as there was no sensation of movement whatsoever.

Headed once more for home, we let down assisted by powerful air brakes, and to burn off some fuel to meet c. g. requirements we cruised around the East Coast, finally coming down to 2,000 ft. below the cloud base. Calling up a nearby U. S. air base where operators are eager to accept anyone to practise let-downs, we proceeded to carry out a GCA approach. With reduced power and flap on we steamed in, and over the runway throttles were opened, up came the flaps again, and we surged up heading for Honington.

The power controls on the *Valiant* are remarkable, and the great machine is easy to handle at any height. Leaning across the pilot I was able to try the wheel, and the aircraft responded smoothly and precisely. The crew were also high in their praise for the Rolls-Royce *Avon* engines which give them power in hand and virtually no bother.

Finally back in the home circuit we turned in, throttled back, applied full flap of 45 degrees and made one of the smoothest landings I have ever had on a big aeroplane with a gentlemanly touch-down at 100 knots I.A.S.

D. H. W.

Before take-off from Honington; left to right: F/O Sherman, second pilot; Derek H. Wood, *Interavia's* London Editor; the navigator; the air electronics officer (on the ladder); S/Ldr. Cox, the captain; and the ground crew chief.

weapons carriers able to deliver an H-bomb from outside defensive radar range. The *Valiant, Vulcan B.1* and *Victor B.1* can also carry the stand-off bomb, and take-off performance with the weapons aboard, even in hot climates, will be maintained by the *Super Sprite* assisted take-off rocket pack on the *Valiant* and a similar pack—presumably with the *Spectre*—on the *Vulcan* and *Victor*.

The Air Ministry is likely to concentrate upon bigger and better stand-off bombs and also improved radar countermeasures to extend the life of the "V" bombers and make up for the gap left by the cancellation of the Avro 730. A victim of the White Paper on Defence, the 730 was to have been a stainless steel, honeycomb-structure bomber capable of M=2.5 cruise at heights around 70,000 ft. The engines would have been eight Armstrong Siddeley supersonic turbojets of a new design.

A new project now looms upon the horizon to take the place of the Avro 730. It has been much mooted (and reported!) that the Air Ministry has a requirement for a supersonic low altitude bomber and this, if built, would undoubtedly replace the *Canberra* and supplement the "V" force. With ground fired guided weapons in the late 1960s likely to make high altitude attack uncomfortable, to put it mildly, the accent is on very fast low altitude sorties with an entirely new type of aircraft.

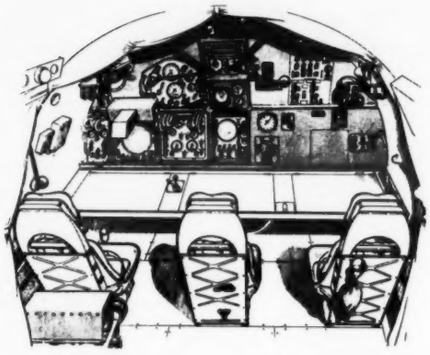
A low altitude bomber is extremely difficult to detect on radar and almost impossible to intercept with present types of guided missile. The major problems which the British industry will have to overcome if they build such a machine are excessive fuel consumption at such heights, aircrew fatigue, and the need for a new type of automatic navigation system.

If these problems are overcome then Bomber Command will continue to be a major part of the British defence system as far into the future as it is possible to see.

The ground crew chief reports to the pilot of a *Vulcan B.1*.

The *Vulcan*'s main undercarriage.

Drawing of the desk for two navigators and the air electronics officer, who in the "V" bombers sit side by side facing the tail.



It is generally known that Great Britain's V-bombers are designed for high subsonic speeds to operate at altitudes of 50,000 ft. with ranges of between 4,000 and 5,000 miles. For security reasons no precise details of performance, loadings, etc. have been released. The following is the available official data to date. *Ed.*

Vickers Type 674 Valiant

A four-jet high-performance swept-wing bomber.
First prototype flew: May 1951.
Entered R.A.F. service: Spring 1955. Now 9 squadrons.
Main dimensions: Span 114 ft. 4 ins. Length 108 ft. 3 ins.
Power units:
a) Mk 1 first production model 4 x Rolls-Royce RA.14 *Avons*.
b) Mk 1 final production version 4 x Rolls-Royce RA.28 *Avons*.
c) 2 x de Havilland *Super Sprite* liquid propellant jettisonable auxiliary take-off rocket motors in below-wing pods.
Speed: Mach 0.9.
Operating altitude: approx 50,000 ft.

Handley Page HP.80 Victor B

A four-jet crescent-wing bomber.
First prototype flew: December 1952.
Entered R.A.F. service: 1957.
Main dimensions: Span 110 ft. Length 114 ft. 11 ins. Height 28 ft. 1½ ins.
Power units:
a) Mk 1 initial production model 4 x Armstrong Siddeley *Sapphire* turbojets.
b) Mk 2 production version 4 x Rolls-Royce *Conway* RCo. 11.
Speed: Mach 1 (with Rolls-Royce *Conways*).
Operating altitude: + 50,000 ft.

Avro Type 698 Vulcan B

A four-jet delta-wing bomber.
First prototype flew: August 1952.
Entered R.A.F. service: 1957.
Main dimensions: Span 99 ft. Length 97 ft. 1 in. Height 26 ft. 6 in.
Power units:
a) Mk 1 first production model 4 x Bristol *Olympus* 100 Series turbojets. 1957: 4 x Rolls-Royce *Conway* turbojets.
b) Mk 2 developed version 4 x Bristol *Olympus* 200 Series turbojets (each 16,000 lb. s.t.).
c) Late 1957 a *Vulcan* equipped with 4 x Rolls-Royce *Conway* bypass engines underwent trials at Malta.
Speed: approx. Mach 1.
Operating altitude: + 50,000 ft.

Valiant "V" bomber with crew, ground servicing personnel, towing vehicle, fuel trucks and other equipment.

New Supersonic Trainer for the U.S.A.F.

The development of the T-38 supersonic trainer, which is destined to replace the Lockheed T-33 as standard aircraft for the training of jet pilots in one to two years' time, was recently described by Welko E. Gasich, Chief Weapon System Development Engineer, Northrop Aircraft, Inc.

Gasich began by discussing his company's decision to create a simple, low-cost jet trainer which could be produced in large numbers but still meet the high standards required of a machine for training in supersonic flight. Some three years ago Northrop learned of the development of jet engines with very favourable thrust/weight ratios (up to 8 : 1) by Fairchild (J83) and General Electric (J85). The company immediately began design studies for an aircraft to reach supersonic speeds easily with two such small engines (each of around 2,000 lb. thrust). Though both the jets in question were at that time destined only for guided missiles, the company succeeded, with the support of the Air Research and Development Command, in obtaining versions adapted for use in manned aircraft. Finally, Northrop completed an aircraft design with aerodynamically refined airframe, which, despite its low weight of around 10,000 lb., met all the requirements laid down by the U. S. Air Force.

Through consistent application of the area rule —in particular in the wing/fuselage intersection region—drag in the near-sonic range was substantially reduced. As the greater part of any training mission is carried out at high subsonic speeds, special attention was devoted to obtaining an optimum leading edge camber to reduce drag. The conical camber distributions which have been used on delta wings were found to be inapplicable to the moderate sweep of the Northrop design's trapezoidal wing. Finally, a wing was designed with optimum, low-drag camber, which retained all the advantages of the straight wing. Particular care was also given to the configuration of the air intakes for the two engines, so as to obtain maximum pressure recovery at the inlets, combined with minimum drag.

The U.S.A.F. specification for a successor to the T-33 included six basic operational requirements: 1 – supersonic flight training; 2 – aerobatic training; 3 – multi-jet training; 4 – cross-country navigation; 5 – night flying; 6 – instrument letdown procedures. To meet these requirements Northrop engineers established the following design criteria: simplicity, ease of maintenance, producibility, safety, light weight. To save weight, for example, use of a ram air turbine for emergency hydraulic and electric power was eliminated, and reliability of these systems was secured by other means.

*

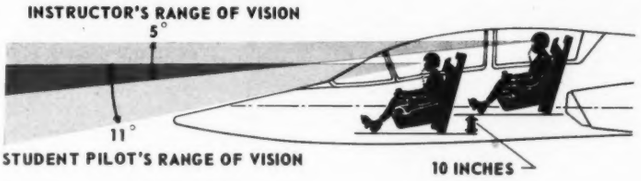
The configuration and structure of the trainer are shown in the accompanying general arrangement drawing. The fuselage contains, from front to rear, communication and navigation equipment, nose wheel, ILS equipment, cockpit with ejection seats in tandem (student in front, instructor behind), fuel tanks flanked by the air intake ducts, two jet engines side by side, with short afterburners. The low-set wing carries only the main undercarriage and is equipped with inboard ailerons and large-area flaps. The very low-set all-moving tailplane is easily controllable and has good stability throughout the speed range.

Wind tunnel tests have shown that the T-38 has excellent lift characteristics at all angles of attack, such that the lift coefficient increases with angle of attack well beyond the stall point—a quality evidently due to the flat, load-bearing fuselage underside. It has also been found that adequate aileron control is available at angles of attack up to 30°, permitting use of the ailerons for spin recovery. These qualities and the good lateral stability experienced in the tests mark the T-38 as a safe, easily operated jet trainer.

*

Northrop is also developing a single-seat lightweight "counterair" (and strike) fighter, the N-156F, derived from the trainer. Also fitted with two jet engines, the new aircraft is reportedly to have similar performance to the heavy fighters of the Century Series. It could be operated from make-shift airfields, sections of highways, etc., and its armament will probably consist exclusively of rockets.

Mockup of the Northrop T-38 supersonic trainer. A removable fuselage rear and large number of inspection ports ensure good accessibility to engines and equipment for maintenance purposes.



Good visibility is provided for both student and instructor.

Cut-away drawing of the Northrop T-38 supersonic trainer.

The Fouga Magister at the Ecole de l'Air

By Colonel Dorance, Second in Command, Ecole de l'Air, Salon-de-Provence

A Fouga *Magister* formation from the Ecole de l'Air.

It was in January 1956 that the French Air Staff decided to post the Fouga CM.170 *Magister* to the Ecole de l'Air as soon as it came off the production line. The school at Salon possessed all the ground equipment needed for the immediate use of the new trainer, the first models of which were delivered in May 1956.

The Fouga *Magister* had already become known through the tests it had made at Mont-de-Marsan, where it had been successfully used for the flying training of eight students chosen at random. But the application of this limited experience to whole classes of students still represented a step into the unknown, since it could not be foreseen how well the average student would cope with a more complex aircraft of modern performance, which also had to undergo technical testing simultaneously with training flights. The problem was still further complicated by the existence of a batch of Morane Saulnier MS. 733 *Alcyons* which the Air Staff wished to utilize during the time the Fouga was available only in limited numbers.

It was therefore planned that training should begin with 30 hours on the MS. 733, followed by 125 hours on the *Magister*. The advantage of this mixed training scheme proved to be nil. The MS. 733 is a good conventional elementary trainer, but its cabin arrangement does not in any way conform to that of the *Magister*. In practice, use of the MS. 733 was of value only to the small number of students who were destined later to fly conventional transport aircraft.

The first Fougas to arrive were used for conversion training of the instructors. Being fully aware of the fact that they were introducing an experiment which had not at that time been tried elsewhere, the instructors were very soon at their ease in the new machine. In particular, the periscope, considered strange during the first flight, was soon found to be an excellent means of providing full visibility forwards.

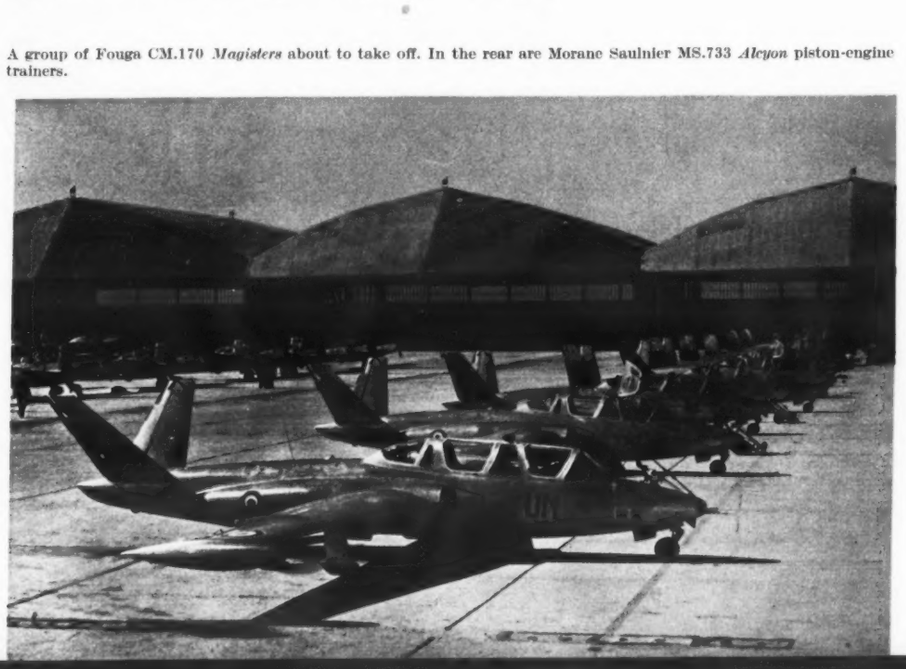
The first group of student-pilots began on the Fouga in October 1956. There is no need to dwell on the delight of a student aged 21 or 22 when he found himself, after more than a year of ground instruction, initiated into the realm which hitherto had been reserved almost entirely for combat units, that of jet engines, pressure cabins and oxygen equipment. Added to this was legitimate pride in being well in the forefront of progress.

The programme adopted at Mont-de-Marsan comprised 14 hours of familiarization, 41 hours of advanced training and aerobatics, 30 hours of instrument flying, 15 hours of formation flying, 12 hours of day navigation, 7 hours of night flying and 6 hours of night navigation, for a total of 125 hours.

Experience showed that students could go solo after an average of 13 hours on dual controls, and the whole programme was completed without difficulty up to the total of 125 hours. None of the exercises raised any problems. Aerobatics, instrument flying and night flying are conventional and extremely pleasant. Formation flying, thanks to the tandem arrangement of the seats, is equally easy either to the right or to the left of the formation leader. Operation is simple and reliable, with the engines being started by means of the aircraft battery. At the beginning serviceability was around 60 percent, rising later to 70 percent.

By the end of October 1956, 85 students had completed their elementary pilot training at the School and passed on to the advanced training establishments; 4 had been eliminated, 60 others were undergoing instruction; 18,200 flying hours and 30,783 landings had been made, with more than 12,000 hours devoted to the training of students proper. No accidents have been recorded. The twin-jet layout of the Fouga, which can still reach an altitude of 10,000 feet on one engine only, eliminates most technical hazards. Reducing the power of one jet immediately after take-off is an exercise which forms a standard part of the programme. Cutting and re-igniting the jets in flight, and aerobatics and landing on one engine present no difficulty; all these manoeuvres help to give the

A group of Fouga CM.170 *Magisters* about to take off. In the rear are Morane Saulnier MS.733 *Alcyon* piston-engine trainers.



The student occupies the forward seat; between the two main sections of the canopy is the instructor's periscope.

student complete confidence, and he thus has to cope solely with the hazards of his own limited skill, and need have no fear of mechanical failures.

To sum up, it is rare that a year's training experience has provided fewer surprises.

It is undeniable that student pilots leaving the Ecole de l'Air are now much closer to their final goal than their predecessors were after 170 hours on piston-engine aircraft. Systematic breakthroughs, and work at altitude out of sight of the ground early give them experience which it previously took many months to acquire.

The jet trainer aircraft has now proved its worth. The constant increase in the number of these aircraft should soon make it possible to train pilots on the Fouga right from the start. That such a scheme is feasible was proved at Mont-de-Marsan, and the past year has amply confirmed the fact. An equally important discovery, at the end of the elementary training course, was that the Fouga had by no means exhausted its resources. The same aircraft can also be used for gunnery and bombing practice and operational training at the specialist schools.

Saunders-Roe SR. 177

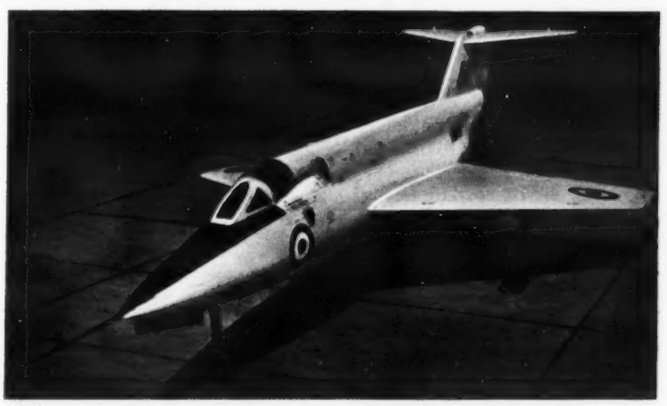
The Saunders-Roe plant in the Isle of Wight is building a small pre-production batch of SR. 177 interceptors under contract to the Royal Navy. However, as the projected order from the German Air Force has not materialized, Saunders-Roe Ltd. has had to abandon plans for quantity production of this supersonic fighter. According to a Ministry of Supply spokesman, the type cannot be considered for the R.A.F., as the White Paper on Defence does not provide for any new manned interceptor apart from the English Electric P. 1. The Royal Navy is basically interested in a naval version of the SR. 177, but small Navy orders alone would not justify the expense of quantity production. The Ministry of Supply has therefore cancelled the whole project. Despite this decision, which may have serious repercussions on part of the British aircraft industry, the design is sufficiently promising to warrant a brief description of its characteristics and development history.

Chief Designer H. J. Brennan describes the SR. 177 as a transition between the manned fighters in service today and the surface-to-air missiles of the future. He stresses particularly that later versions of the SR. 177 could be converted into unmanned missile carriers. Even the models being built today are equipped with fully automatic programme control for climb and target approach. Choice of the powerplant was dictated by the following considerations: the engine-plus-fuel weight (including the fuel required for a given endurance) of a pure jet becomes increasingly less favourable compared with that of a rocket engine, the shorter is the required time of climb. In other words, the higher the rate of climb demanded, the more favourable the rocket engine appears, particularly as its thrust increases with increasing altitude. To combine good climb performance with adequate endurance, Saunders-Roe designers decided on a mixed propulsion system, consisting of a de Havilland *Spectre* rocket motor (for rapid climb and turns at altitude) and a de Havilland *Gyron Junior* jet engine (for other flight phases).

The combination of power units dictated the airframe design, which—like the arrangement of the engines one above the other—is a logical development of that of the SR. 53 prototype shown at Farnborough in 1957. Maximum gross weight of the SR. 177 is according to the manufacturers, roughly 25 percent higher than that of the SR. 53, an increase which is due primarily to the more powerful turbojet and the bigger fuel and propellant capacity. One interesting feature is that the jet engine is mounted in the lower half of the fuselage, with the rocket engine above it—the opposite arrangement to that in the SR. 53. The air intake for the turbojet is beneath the fuselage nose and closely resembles, as regards position and configuration, the air intake in the Hawker P. 1121. The pointed nose houses navigation and fire control radar and radio equipment. The model pictured here shows two air-to-air missiles of undisclosed type at the wing tips—probably a development of the *Firestreak*.

Originally designed to be capable of operating from carriers, the production model of the SR. 177 was to have had jet flaps. The short take-off and landing distances thus obtainable would also have been of great value to the land-based version, and the relatively light-weight supersonic fighter could have been employed at forward airfields. All that has been revealed of the SR. 177's performance is that top speeds were to have been in the region of Mach 2, and service ceiling "substantially higher than that of aircraft in use today."

Meanwhile Saunders-Roe has released first details of an improved version of the SR. 53, which has been undergoing flight tests at Boscombe Down, near Bournemouth, since December 18th, 1957. The new version, like its predecessor, is powered by an Armstrong Siddeley *Viper* jet and a de Havilland *Spectre* rocket engine, but the rocket propellant tanks have been considerably enlarged, so that the *Spectre* has a much longer endurance. Here, too, it should be mentioned that Saunders-Roe is now offering a more powerful version of the SR. 53, with a *Viper* of more than 2,500 lb. static thrust without reheat. The company seems determined to break into the market for light-weight fighters, and it may be that the stubbornness with which it is promoting its design will one day bear fruit.



Saunders-Roe SR. 53 experimental fighter, fitted with one Armstrong Siddeley *Viper* jet and one de Havilland *Spectre* rocket engine (top). Below, a model of the SR. 177 with de Havilland *Gyron Junior* jet plus de Havilland *Spectre* rocket engine.

Modern Uses of Parachutes

By Lyman H. Ford, President and General Manager, Pioneer Parachute Company, Inc., Manchester, Conn.

The author has been in parachute work for 35 years. He has made hundreds of jumps personally, introducing and demonstrating the free-type manually operated parachute in many countries throughout the world. In 1922, while serving as a Chief Petty Officer in the U.S. Navy, Ford was assigned to parachute work and sent to the U.S. Air Corps parachute school for training. Subsequently, when the U.S. Navy established its first parachute school in 1924, he became chief instructor.

In 1926, Ford transferred to the Naval Fleet Reserve and joined the Irving Air Chute Company of Buffalo, New York. In 1938, he helped to found Pioneer Parachute Company, Inc. During World War II, under his management, Pioneer manufactured more parachutes than any other company in the world. Ford has guided its subsequent research and manufacturing work, which have given Pioneer parachutes an integral role in the development of the jet and rocket age.

When U. S. Air Force Major David G. Simons rode to the edge of space last August, setting a new record more than 19 miles above earth, he had three Pioneer parachutes with him. He used one to drop off two 50-pound battery packs when thunderheads rose dangerously close. There was a big parachute, rigged to the gondola, and in the event of trouble Simons could separate gondola from the balloon and float to earth in his aluminum capsule. He also wore his personal parachute, outside his high-altitude pressure suit, in case the capsule itself should split open.

Major Simons fortunately did not have to use two of his parachutes. But we at Pioneer know that, had he had to resort to them, they would have done their job, as the first one did. For the three parachutes on this historic balloon ascension epitomize much of the story of the modern parachute industry.

Parachutes, once used for the single purpose of saving the lives of individuals in event of fire, collision, or structural failure of an airplane in flight, are now used in many different ways. They serve as rudders, stabilizers and brakes on all manner of objects designed for passage through the air. They can lower safely to earth almost anything which travels in the air, regardless of its size, the speed at which it travels, or the atmospheric conditions. Moreover, *parachute design and manufacture has progressed from an art to a science.*

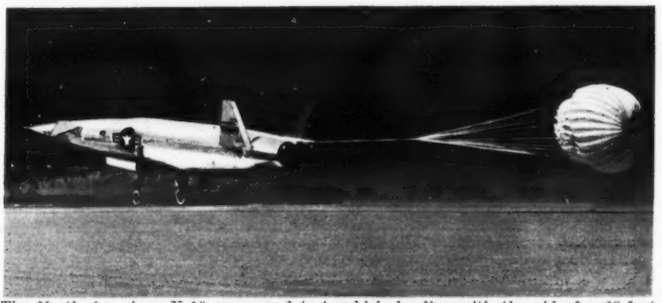
Every year we build hundreds of parachutes for use with prototype vehicles. They cannot be tried out in actual use before they are put to the crucial test. But with their research and resources, their experience and their ingenious testing devices, the engineers in our plant and laboratories in Manchester, Connecticut, can design a parachute for any new use and manufacture it with the certainty that it will function correctly.

The first "new use" of parachutes was for materiel delivery. Parachutes were designed to carry from plane to ground all sorts of articles, from packets of food or medicine to huge armored vehicles and heavy weapons. A dramatic outgrowth of this is the use of parachutes in air-sea rescues, by which lifeboats or liferafts are dropped to persons struggling in the water. For these purposes, parachutes have to be designed to carry the varying weights safely. It is also important—sometimes, as in rescue work, of critical importance—that the articles be landed with pinpoint accuracy.

Pioneer parachutes are used also with radiosonde balloons, sent aloft by meteorologists to take atmospheric measurements. When the balloon finally bursts, perhaps 100 miles above earth, the instrument case is automatically disconnected and floats safely back to earth.

The development of successful rockets, missiles and satellites might never have been possible without parachutes. Certainly it could have been done only at much slower pace, and at a cost of many extra millions of dollars. Throughout its flight into the unknown, the rocket or missile is recording

Towing a ring slot parachute 16 feet in diameter behind it to improve landing safety, a Boeing B-47 comes in to land at a steep angle.



The North American X-10 unmanned test vehicle landing with the aid of a 28-foot ribbon parachute.

On landing, a Boeing B-47 is braked by a 32-foot ribbon parachute which exerts a drag force of 38,000 lb. at 160 knots. The same parachute is used in the event of an aborted take-off.

This Boeing B-52 uses a 44-foot ribbon parachute for landing braking and to stabilize the aircraft on slippery runways.

priceless information on precision instruments built into it. At completion of its mission, the missile separates in flight, and it is then the parachute's job to bring the instrument and power sections safely back to earth. This involves a radically different use of parachutes because, traveling at supersonic speed, the recoverable parts must first be decelerated and stabilized, then lowered to the ground. These several functions may be performed by a series of parachutes, or by a special method of deployment of a single parachute. When the entire missile is to be recovered, parachutes again can do the job. They bring the missile under control safely and effectively, then lower it to the ground.

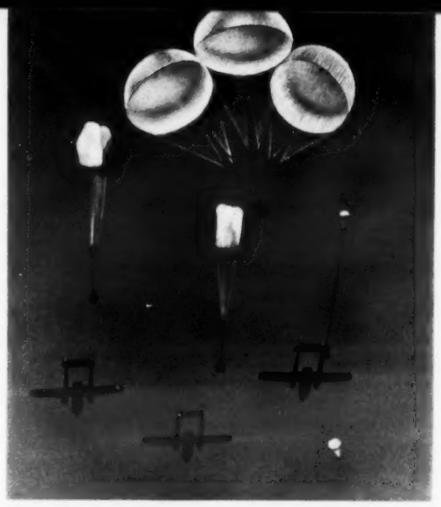
High-speed targets likewise are recovered by parachute, and more than 150,000 safe recoveries have been recorded. The speed of the target is first reduced by a drogue parachute, then a large conopy floats the target to earth. When a target is destroyed by missile or by accident, the pods containing recording cameras and other devices are saved by means of parachutes.

The high approach and landing speeds required by jet planes provide still another use for parachutes. A landing approach parachute lets the pilot come in at a steeper angle than he otherwise could, as well as allowing him to maintain safe engine thrust and maximum generator output for accurate instrument readings. After landing, another larger parachute is used as a brake. This shortens the roll faster than wheel brakes, and is particularly effective when runways are slippery. They pay for themselves over and over by reducing wear on tires and braking systems and by reducing landing hazards.

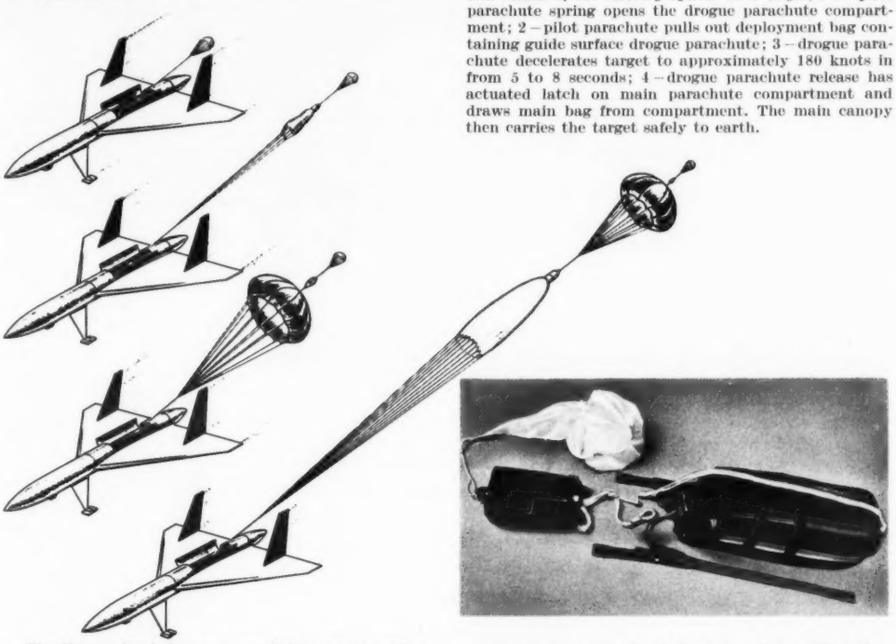
Pioneer makes parachutes for deceleration and braking of the biggest bombers, and smaller models for use on jet fighters and other lighter planes; on aborted take-off, they are twice as effective as brakes.

Another important use is in connection with the extra fuel tanks carried on wings of such planes as the B-52 and B-47 bombers. These tanks are jettisoned when empty, but they formerly failed to drop free and often hit part of the aircraft. Pioneer parachutes now are incorporated in the tail cone of the wing tanks, and with automatic timing first releasing the parachute, then exploding the holding nut, the danger is eliminated; both 1,000-gallon and 3,000-gallon tanks, empty or full, are pulled clear of the plane immediately upon release.

The stabilization qualities of parachutes have other uses for which we manufacture special models. Parachutes are made to bring airplanes out of spins during testing. They have saved the lives of many pilots, not to mention the millions of dollars in planes themselves. By permitting the test aircraft to be saved, they have enabled engineers to incorporate the extra safeguards needed to make the plane safe for normal flight.



Big 100-foot Pioneer parachutes, used either singly or in groups, are employed to drop heavy military loads from transport aircraft.



Successive stages in the recovery of a high-speed target (left) and details of the recovery system used (right): 1 – pilot parachute spring opens the drogue parachute compartment; 2 – pilot parachute pulls out deployment bag containing guide surface drogue parachute; 3 – drogue parachute decelerates target to approximately 180 knots in from 5 to 8 seconds; 4 – drogue parachute release has actuated latch on main parachute compartment and draws main bag from compartment. The main canopy then carries the target safely to earth.

Similar principles are used in constructing parachutes for use on bombs, mines and aerial torpedos. They provide more accurate patterns in bombing and mine laying, replacing the conventional fins on aerial torpedos, doing the job of stabilization more effectively.

*

With the wide variety of uses of parachutes in the modern world of aerial flight, most of them undreamed of a dozen years ago, each new use calls for a specific new design.

Pioneer engineers have many factors to take into consideration in designing each parachute. At what speed will it be put into use, and to what speed must the object be decelerated? At what altitude will the parachute be employed? Under what atmospheric conditions? What are the shape, size and weight of the loads to be handled? What are the landing requirements, in terms of accuracy and delicacy of setdown? For what functions is the parachute to be designed – stabilization, deceleration, lowering, or a combination of two or all of these?

Depending upon the answers to these questions, the engineers at Pioneer may decide the job can be performed with one parachute, or with a recovery system of parachutes. The design must take into account the required drag characteristics which are almost wholly controlled by canopy configuration. Some of the more familiar basic canopy designs are the solid type, the various guide surface designs, the ribbon and the ring slot canopies.

Some special design parachute systems incorporate individual features of the various basic designs. The parachutes of one type, too, will vary widely, according to the use to which they will be put. The size, weight and strength of the fabric will be specified in accordance with the job to be done. The size of the thread, and even the number of rows of stitching, will vary.

The method of suspension of the load will be tailored to the task. The conditions of operation will determine the method of release. Even the packing of the parachute will be designed to accord with its method of use.

The manufacture of personnel parachutes, of course, continues. They are needed. and always will be, for fliers in distress, for paratroopers being dropped into inaccessible areas, for devotees of the sport of "sky diving".

There is a world of difference, however, in what is required of a parachute when a man bails out of a propeller driven airplane at less than 100 knots, and when a pilot is exploded out of a jet plane at hundreds of knots.

The refinements in design all along the line are exemplified in today's personnel parachutes. More revolutionary changes will be seen in the results of work being carried on right now by Pioneer Parachute Company under the secrecy of security regulations.

Elephants Land as Gently as Cats

Goodyear's landing mats

"And then I hit the silk" . . . The classic phrase conjures up a vision of a pilot parachuting safely to the ground as his disabled aircraft plunges to destruction. Perhaps it will soon be possible to add: ". . . but the aircraft landed without me with its parachutes and rubber mat." There is every indication that the development work currently being done on aerial recovery systems for whole airframes or heavy loads will yield positive results before long. Then elephants will be able to land as gently as cats . . . supported by the silk of giant parachutes.

One of the first public indications that government and industry are working in this area came in October 1957 with the announcement by The Martin Company, of Baltimore, Maryland, that a recovery system consisting of parachutes and rubber deceleration bags had been used successfully by the U. S. Air Force to recover the Martin TM-76 *Matador* guided missile (picture). Previously, the jet-powered *Matador*, which has the general lines and size of a fighter, was a one-shot weapon. Each missile launched was inevitably destroyed. It was a costly operation, particularly during training periods.

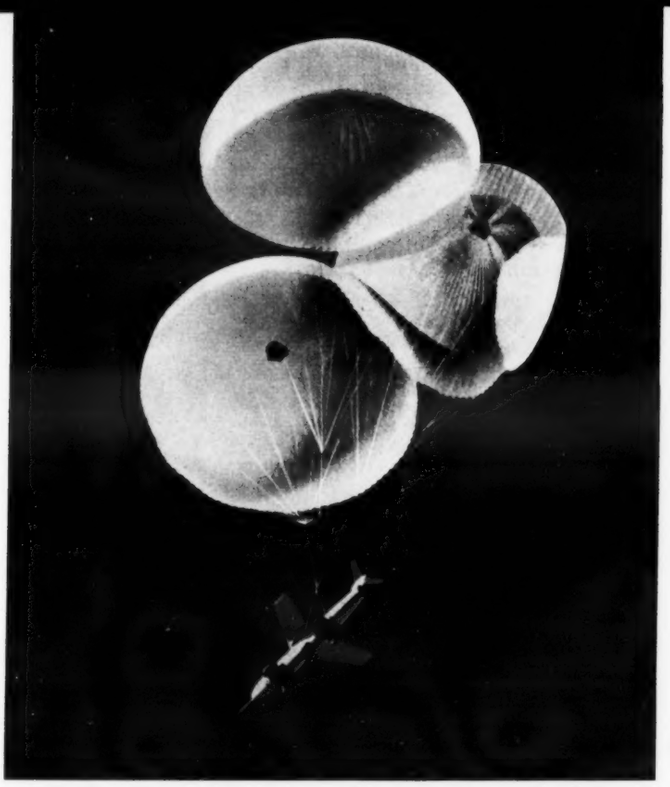
With the recovery system, the "ground pilot" handling the missile's command mechanism now is able to bring the weapon down whenever he pleases. All he has to do is throttle the vehicle's jet engine to 60 percent power, eject a drop parachute to brake the missile's high speed, deploy three 100-foot cargo parachutes at 2,500 ft. and, as the *Matador* nears the ground, inflate large fabric air cushions to absorb the landing shock.

The air cushions were specially adapted for the *Matador* by the Aviation Products Division of The Goodyear Tire & Rubber Company, of Akron, Ohio, and are made of highly stressed, temperature-resistant neoprene-coated nylon fabric. They are inflated by compressed air, and diaphragms control the escape of air to prevent blowouts and sudden load shocks upon landing. The sausage-shaped deceleration mats are mounted in pairs fore and aft, roughly equidistant from the vehicle's centre of gravity.

Use of this recovery system will probably not be restricted to the *Matador*. For example, target drones used for missile firing tests or reconnaissance missiles could be adapted for recovery. There is even serious discussion of using the parachute-plus-mat system for recovering manned aircraft up to a certain weight—including supersonic and high-altitude vehicles—in emergencies.

Goodyear has been working in the field of deceleration and recovery systems since 1950 and has devoted an increasing amount of engineering time to the development of reliable recovery systems for guided missiles, free fall containers and aerial drop platforms. In 1956 the company was successful in developing a free fall inflatable radio transmitter container which absorbed ground impact load shocks to the extent that the undamaged transmitter was able to right itself automatically and begin operations. The container was air-dropped as many as a hundred times without damage during free fall tests.

One of the more spectacular applications, however, is the perfecting of drum-shaped air bags for use on huge magnesium aerial rafts produced by Brooks & Perkins, Inc., of Detroit, Michigan (picture). Carried on a roller-type conveyor in an aircraft's cargo compartment, these rafts are loaded with the most varied equipment and are ejected from the aircraft and



New type of recovery system to enable the Martin TM-76 *Matador* guided missil to bee re-used for training and test purposes. Three large cargo parachutes and four inflatable air bags bring the missile gently down to the ground when its flight is completed.

Under contract to the Wright Air Development Center, Goodyear Aircraft Corporation, a subsidiary of The Goodyear Tire & Rubber Company, has made a series of tests with large free-falling parachute models (time stroboscopic exposures) in its 200-foot high airship dock at Akron, Ohio.

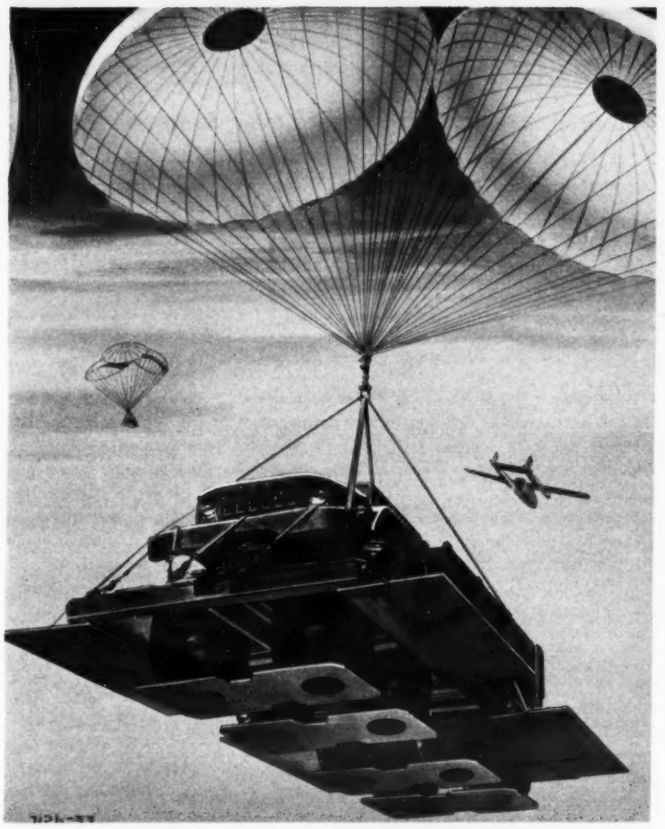
lowered to the ground by parachute. During descent, plywood doors, restraining collapsed air bags, spring open to permit the bags to inflate. Uprushing air does the job in sufficient time to cushion the fall of the platform when it hits the ground. As in the case of the *Matador* missile air bags, diaphragms control the escape of air to prevent blowouts and sudden load shocks upon landing. The out-stretched plywood doors prevent the raft from tipping.

Brooks & Perkins manufactures platforms in 11-foot, 15-foot and 24-foot sizes. The smallest unit accommodates 5,000 lb. loads and uses four air bags. The largest platform, with 20,000 lb. capacity, uses 12 cylinders. Use of these aerial platforms to get large equipment into action safely gives U. S. paratroopers new mobility and firepower. With the ability to go into action with howitzers, jeeps, tractors, graders and heavy supplies, instead of being dependent on small arms and skill at hand-to-hand combat, paratroopers face bigger and more complex missions.

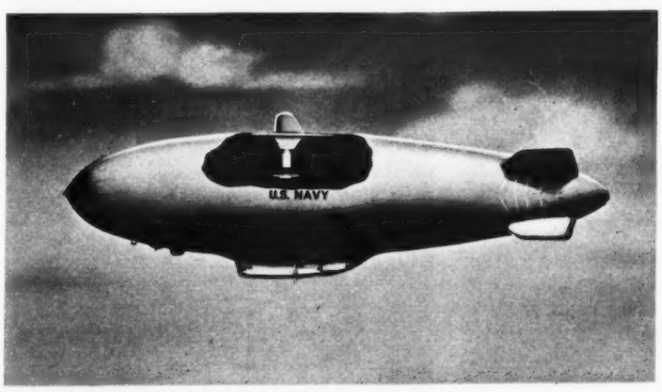
The drum mat, most commonly used on aerial platforms, is fabricated of light-weight neoprene fabric. Since the fabric can be reinforced with wire cable, it is possible to use a lighter material than specified for other types of mat. The drum mat folds neatly into a cavity and is recoverable for re-use.

*

Research engineers at Goodyear Aircraft Corporation, Akron, a subsidiary of The Goodyear Tire & Rubber Company and manufacturer of large numbers of blimps for naval and radar reconnaissance, have been carrying out their own tests with parachutes, using the firm's spacious airship dock. By dropping large parachute models from the ceiling, a distance of 200 feet to the floor, comparison data of such properties as flight path, stability, weight-carrying ability and opening characteristics of various types of parachute have been gained.



Drawing of a Brooks & Perkins aerial drop platform, with eight drum-shaped Goodyear air cushions to absorb landing shocks. The series of "barrels", made of neoprene-coated nylon fabric and reinforced with wire, are inflated with compressed air during descent. Diaphragms control the escape of air to prevent blowouts on impact.



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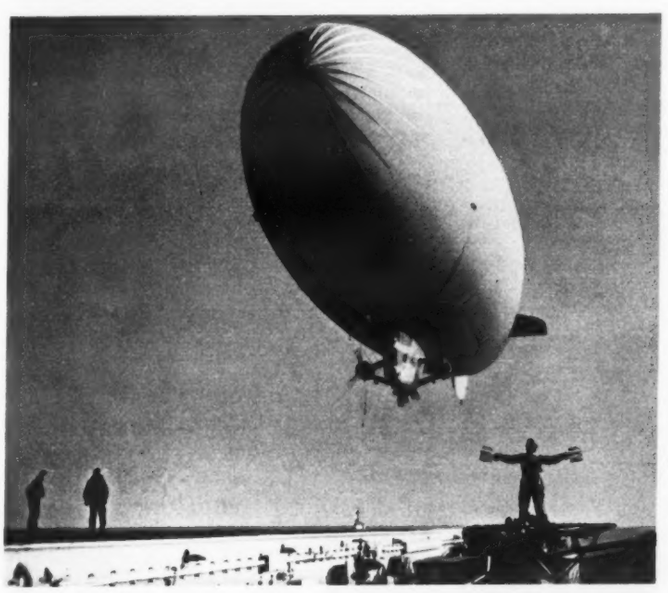
Goodyear Aircraft Corporation products: The U. S. Navy units attached to North American Air Defense Command use large Goodyear ZPG-2W blimps (picture above left) carrying giant antennas internally for radar early warning at sea. The lower picture shows an older Goodyear blimp (Type K, 425,000 cu. ft. of helium) landing on a U. S. aircraft carrier. – Right, the Goodyear "inflatoplane", an inflatable aircraft manufactured for the Office of Naval Research. Wing, tail assembly and cockpit are made of two walls of rubberized fabric connected by nylon threads, and power is supplied by a 44 h. p. Nelson engine. Rotor blades can also be manufactured in the same manner.



Rockets, Missiles and Space Vehicles

United States defence budget proposals for the fiscal year 1958/59 earmark no less than $ 5,300,000,000 for the development of guided missiles and rockets. President Eisenhower is surrounding himself with a staff of rocket experts. Great Britain is acquiring an arsenal of surface-to-air weapons and is also developing a strategic medium-range missile. In continental Europe, France, Germany and Italy are organizing an international pool for the development of tactical guided weapons. Soviet Russia alerted the Western world with news of her operational long-range space weapons and, following the launching of the two Sputniks, *is now preparing for space travel. The major powers are being compelled to restudy their research, industrial, strategic and political policies.*

In view of the importance of these developments Interavia *will carry a regular feature under the title of "Rockets, Missiles and Space Vehicles" to present a report of the progress in the various fields associated with this theme. It is to be hoped that time will bring a greater emphasis on civil projects.*

● **The Convair SM-65 Atlas:** After two failures and two successful test launchings, further development of the *Atlas* I.C.B.M. is being speeded up, and additional funds have been made available. The 1959 fiscal budget proposals include a 30% increase in the originally voted resources.

The first successful *Atlas* test launching took place on December 17th, 1957, and the second on January 10th, 1958. Both launchings were carried out at the Cape Canaveral test range and were described by the Department of Defense as "tests over reduced range". In both instances the power units and guidance systems appear to have functioned satisfactorily. Assuming the successful testing of further components the *Atlas* could be put into production in about a year. According to a statement by J. R. Dempsey, Director of Convair's Astronautics Division, the cost of one production model Atlas, taking into consideration the necessary research and development expenses, is in the neighbourhood of $2,000,000. Following the first successful test launching Dempsey told a Washington press conference that the *Atlas* could place an approx. 1,000-lb. satellite in orbit about one year after governmental approval of the necessary programme. The appropriate contracts can be expected in the near future.

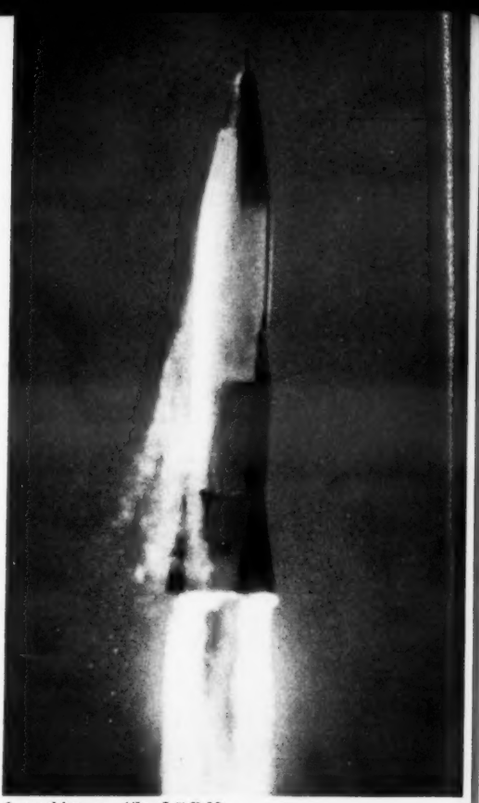
Information regarding the structure of the 220,000-lb. missile is sparse. Such details and photographs as have been made available present the following picture: the snub nose-cone is very similar in shape and size to that of the U.S.A.F.'s *Thor* I.R.B.M., and separates from the rocket body before re-entry into the earth's atmosphere. The cylindrical rocket body is reportedly of integrally stiffened half-shell sheet construction and serves as a propellant container. Mounted side by side in a conical fairing at the rear of the body are two North American Rocketdyne S.3 rocket engines, each with a thrust of 165,000 lb., on parallel gimbal mountings some ten feet apart. After burnout of the two launching rockets, a third centrally located rocket motor (also developed by North American) with a thrust of approx. 65,000 lb. powers the vehicle into the ballistic flight stage. Estimated dimensions: length approx. 80 ft.; diameter 10.5 ft.; overall width over engine fairing 17.5 ft.

Atlas development is the work of Convair, for the airframe, and Rocketdyne Division of North America, for the propulsion units, together with the following firms: General Electric Co.'s heavy military electronic equipment department and Burroughs Corp. for the control and guidance system; American Machine & Foundry Co. for auxiliary equipment power units; General Electric Co., Missile and Ordnance Systems Dept. for the nose cone.

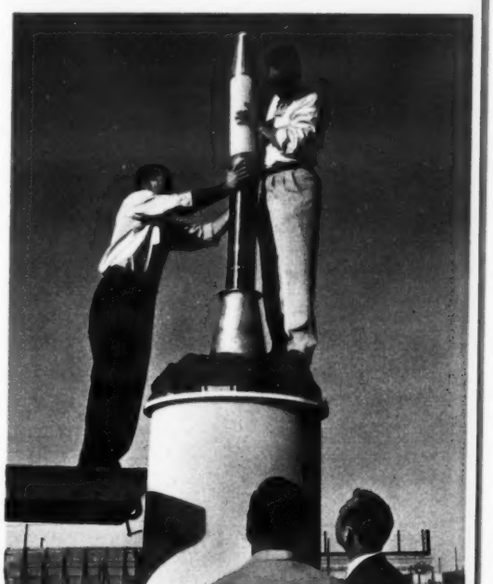
● **Douglas Thor:** Developed under the supervision of the U.S.A.F.'s Ballistic Missile Division, this I.R.B.M. has also achieved a successful series of test launchings and is now in production. The *Thor*, which can be described as a "smaller brother" of the *Atlas*, not only has a Rocketdyne S.3 main power unit, as employed in pairs in the *Atlas*, but also utilizes other components and equipment systems employed in the I.C.B.M. (e.g., nose cone with H-warhead, control and guidance systems); the airframe structure itself has certain basic similarities. Major General Schriever, Director of the Ballistic Missile Division, has recently stated that production engineering of the *Thor* is about one year ahead of the *Jupiter*, the sister weapon developed by the U.S. Army.

Available technical details of the *Thor* I.R.B.M. are as meagre as for the *Atlas*. The weight is believed to be about 100,000 lb., so that with a 165,000-lb. thrust power unit it can be expected to have an initial acceleration comparable to the larger Convair missile. Range is reportedly in excess of 1,300 nautical miles.

With an overall length of 57 ft., the *Thor*'s overall diameter is approx. 8 ft. Four small fins with aerodynamic surfaces are mounted at the rear of the airframe for control during the first phase of the trajectory; during the major portion of the rocket-powered trajectory, control and stabilization are by means of

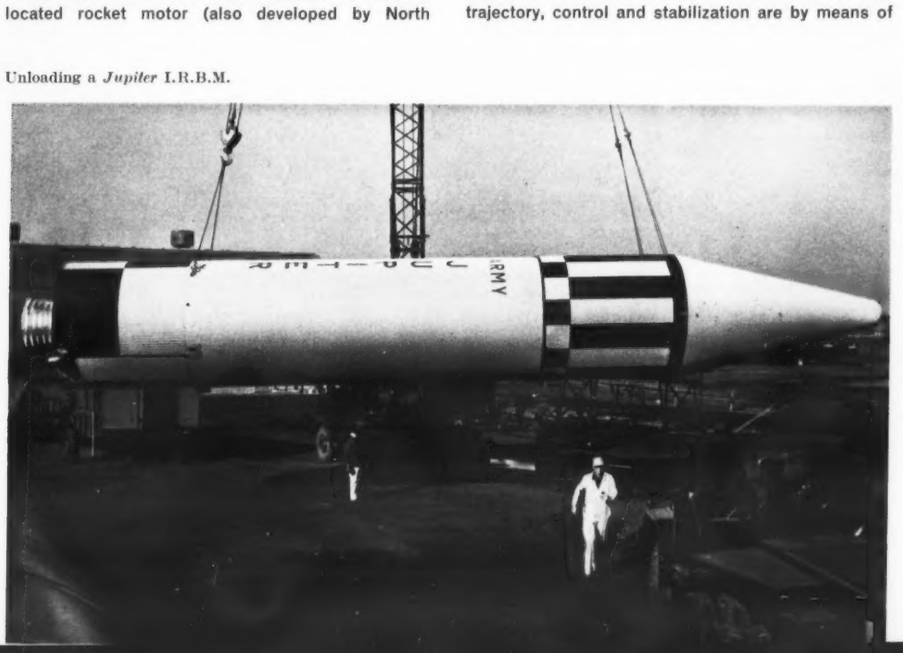


Launching an *Atlas* I.C.B.M.



The U.S. Army's small satellite will be mounted in the final stage of a *Jupiter C* experimental vehicle.

Unloading a *Jupiter* I.R.B.M.



Rear of the *Jupiter*, with propulsion unit covered.

The 22,000-lb. Chance Vought *Regulus II* surface-to-surface vehicle is now being launched with the aid of a 20-foot long, 115,000-lb. thrust booster rocket whose oblique downward thrust lifts it into the air at an angle of roughly 30°. The 4,500-lb. booster rocket has a burning time of 4 seconds; at burnout the *Regulus II* has a speed of approximately 280 knots, but finally reaches supersonic speeds.

the deflectable thrust, as in the *Atlas*. Initial production of the I.R.B.M. is planned at Douglas' Culver City, Calif., plant which is capable of producing several dozen missiles per month when the programme is under way.

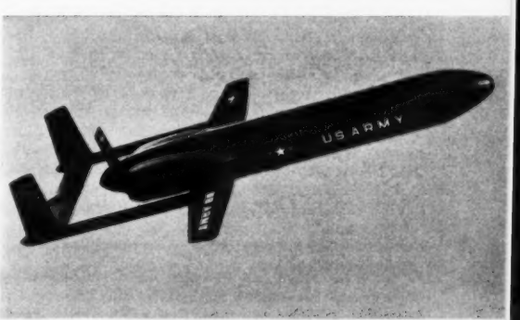
● **Chrysler Jupiter:** Third ballistic missile in the United States arsenal, the *Jupiter* I.R.B.M. was developed by the U.S. Army's Ballistic Missile Agency, and is now being brought into production. At the beginning of January the U.S. Army announced the allocation of a $30,000,000 initial production contract to Chrysler. Two U.S.A.F. missile units are being established and will shortly be equipped with *Jupiter* and *Thor* weapons. Training in both weapons will begin immediately, in order that I.R.B.M. units will be available for stationing in Europe by the end of 1958, as planned.

Both structure and configuration of the *Jupiter* differ clearly from the *Thor* sister weapon, although in performance the two missiles are probably very similar. *Jupiter* is also powered by a gimballed Rocketdyne S.3 rocket motor, but aerodynamic stabilizing fins have been entirely omitted. The approx. 2,200-lb. nose cone, with either A- or H-warhead, is considerably more pointed than either of the two U.S.A.F. missiles. The length of the *Jupiter*, excluding the rear-protruding rocket motor, is approx. 54 ft., diameter 7.7 ft., and weight about 100,000 lbs.

● **U.S. Army Satellite Programme:** In conjunction with the Jet Propulsion Laboratory of the California Institute of Technology, the U.S. Army Ballistic Missile Agency is preparing the launching of small satellites. The accompanying picture shows a shell-shaped satellite, approx. 30 inches long, mounted on an equal diameter solid-propellant rocket; the vehicle will be driven by a further group of solid-propellant rockets, the whole being installed in the nose of a *Jupiter C* experimental vehicle. This three-stage launching vehicle is expected to give the satellite the required separation velocity of 18,000 m.p.h. The small satellite is designed for research into cosmic radiation, temperatures and meteorites, and launching is planned for this spring.

● **The U.S. Army's new missile projects . . .** A Defense Department list of guided weapons now under development includes the first official mention of the U.S. Army's *Nike-Zeus* weapon system; this is, in essentials, an anti-missile missile, i.e. a surface-to-air missile with nuclear warhead for employment against attacking I.C.B.M.'s or I.R.B.M.'s. Development work on this project is being carried out by the same firms who are responsible for the *Nike-Ajax* and *Nike-Hercules* projects: Western Electric Co.—main contractor; Bell Telephone Laboratories—developers; Douglas Aircraft Co.—principal sub-contractor. The U.S. Army is also studying the *Talos Defense Unit*, a land-based weapons system version of the U.S. Navy's *Talos* surface-to-air weapon. The U.S. Army plans to convert this weapon, developed by the Radio Corporation of America, for integration in its Air Defense System.

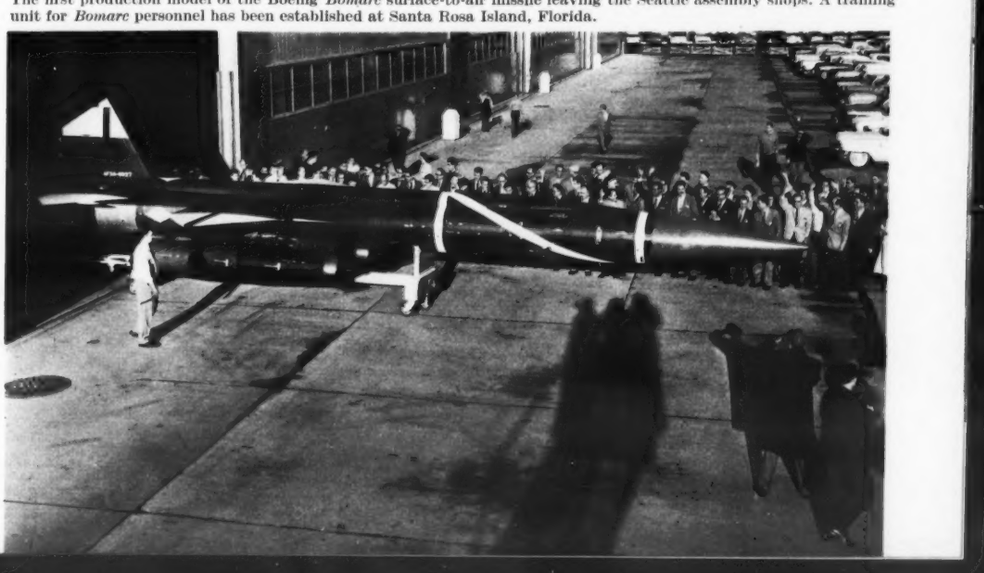
. . . and the U.S. Navy's: The list of guided missiles, mentioned above, also includes the U.S. Navy's new *Sparrow III* air-to-air rocket missile, which is being manufactured by Raytheon Manufacturing Company. This weapon will later replace the *Sparrow I*, which has been in service with the Navy since 1956; some 12 feet in length, and with a weight of 350 lbs., the new missile attains a speed of over 1,500 m.p.h. within seconds of launching. The standard Navy fighters can carry two to four *Sparrows*. Raytheon, under agreement with the Navy Bureau of Aeronautics, is now manufacturing *Sparrow III* at the Naval Industrial Reserve Plant, in Bristol, Tennessee, which the Sperry-Farragut Company formerly used for *Sparrow I* production. Douglas Aircraft Co. has developed the *Sparrow II* as an experimental missile, but this is not intended for use by the U.S. Navy. The *Tartar* surface-to-air missile is a junior version of the *Terrier* missile, but has about the same range and the same warhead. Designed especially for use in the DDG-class destroyers now under construction, the *Tartar* is a solid-propellant rocket and is being built by Convair Division of General Dynamics Corporation at Pomona, Calif. The small dimensions of the *Tartar* permit its use in destroyers and as the secondary armament of larger ships, where it will replace 5-inch guns. The *Bullpup* tactical air-to-surface missile is designed for employment by carrier-based Navy and land-based U.S. Marines combat aircraft. Built by the Orlando, Florida, Division of The Martin Company, the *Bullpup* is 11 feet long, weighs approx. 540 lbs., has movable canard control surfaces, and is powered by a solid-propellant rocket; this missile is relatively inexpensive in production, of simple design, but is highly accurate in operation against smaller targets such as pill-boxes, tanks, road convoys, bridges, marshalling yards, etc.



The Republic SD-3 unmanned reconnaissance drone has three interchangeable nose units for either photographic, radar or infra-red reconnaissance missions. The SD-3 is propeller-driven and is launched from a special platform with the aid of booster rockets; recovery is by parachute.

The Lockheed Q-5 supersonic target drone is ramjet-powered (below the fuselage). Two solid-propellant rocket motors are utilized for launching, and the 7,600-lb. drone achieves speeds in the order of Mach 2 at high altitude.

The first production model of the Boeing *Bomarc* surface-to-air missile leaving the Seattle assembly shops. A training unit for *Bomarc* personnel has been established at Santa Rosa Island, Florida.



What's in the Air?

Extracts from Interavia Air Letter, *daily international news digest, in English, French and German. All rights reserved.*

Lieutenant General Silvio Napoli, Italian Air Force, succeeded General Ferdinando Raffaelli as Chief of the Air Staff on February 1st, 1958. He was born in Reggio di Calabria on July 17th, 1902, and entered the Air Force in 1925. In 1933 General Napoli participated in the Orbetello – Chicago – New York – Rome flight under Marshal Italo Balbo. After World War II he was appointed Adjutant to the Chief of the Air Staff, and later became Inspector General of Communications and Air Traffic Control. Until his appointment as Chief of the Air Staff, General Napoli was Chief of the Defence Minister's Personal Staff.

AIR TRANSPORTATION

● **The German Lufthansa**, according to provisional estimates, carried a total of 386,000 passengers, 3,248 tonnes of freight and 1,609 tonnes of mail in 1957, compared with 229,670 passengers, 1,990 tonnes of freight and 1,050 tonnes of mail in 1956. This represents an increase of 68, 63 and 53 percent respectively. At the end of 1957, Lufthansa's fleet included nine long-range airliners, nine medium-range aircraft, three short-haul transports and twelve trainers. The number of passenger-kilometres rose 53 percent (from 558,055,000 to 858,232,000), but operating costs increased only 48 percent. The average passenger load factor was 57 percent, some 10 percent higher than in the preceding year.

● **Scandinavian Airlines System** accounts showed a net profit of 10,500,000 Swedish crowns for the year ending September 30th, 1957, equalling the figure for 1955/56. Total revenues were 497,700,000 crowns, and total expenditure 487,200,000 crowns. In the year under review, S.A.S. carried a total of 1,396,000 passengers, 11,200 tonnes of freight and 5,200 tonnes of mail. Revenue tonnes-kilometres rose from 144,000,000 in 1955/56 to 180,000,000.

● **Japan Air Lines:** By September 30th, 1957, Japan Air Lines had carried 1,593,514 passengers on its domestic routes since services were inaugurated in 1951. On international flights, the number of passengers reached 108,938, making an overall total of 1,702,452. The total distance flown by J.A.L. aircraft in that period amounted to 15,245,654 miles on domestic routes and 12,217,145 miles on international services — 27,462,799 miles in all. Revenues for the period aggregated 23,018,241,769 yen ($ 63,930,560) and expenditures 22,876,945,763 yen ($ 63,547,071). Thus at the end of September 1957 a profit of 141,296,006 yen ($ 382,489) remained. J.A.L. operated at a profit only 13 months after beginning operations.

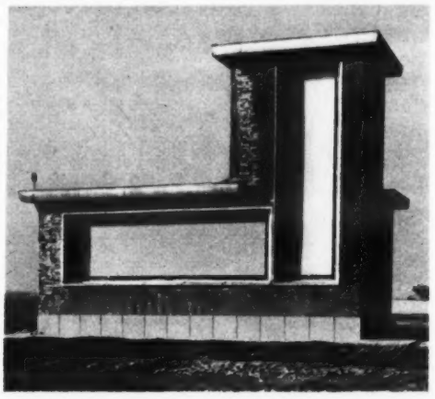
● **U.S. domestic airlines** showed a 39.2 percent decline in net operating income for the first ten months of 1957 compared with the corresponding period in 1956. A survey compiled by Brooks Earning Indicator, Inc., revealed that the twelve major domestic airlines had a net operating income of $ 69,806,000 for the period January-October 1957, compared with $ 114,826,000 for the same period of 1956. The loss of income came despite a 13.4 percent increase in revenue passenger-miles, and a 12.4 percent rise in total operating revenues. This was offset by an 18 percent increase in total operating expenses.

● **A new project** has been submitted for the expansion of Zürich-Kloten Airport. It is planned to extend the instrument runway to 11,500 feet and the west runway to 8,200 feet; the apron is to be enlarged to 722 × 2,296 feet, and the number of hard standings will be increased from 16 to 28. The total cost of the new project amounts to 73,700,000 francs. Of this, 32.5 percent will be payable by the Federal Government. The Canton of Zürich will be asked to raise 53,500,000 francs, of which the city of Zürich and the town of Winterthur will probably contribute 5,500,000 francs. A separate project by Flughafen-Immobilien-Gesellschaft calls for an expansion of the terminal building, construction of an office block, a mail and freight block and facilities for the Swissair technical services. The project is estimated at 51,150,000 francs, or 37,360,000 francs after deduction of Federal subsidies. A larger and more expensive project was rejected by the voters of the Canton of Zürich last summer.

● **The Paris Airport Authority** announces the following operating figures for Orly and Le Bourget Airports during 1957 (in brackets the corresponding 1956 figures): 2,685,044 (2,416,776) passengers, 111,621 (103,909) aircraft movements, 42,512 (42,160) tonnes of freight, 13,648 (12,669) tonnes of mail. 974,936 people visited the airports during the year under review.

● **A new civil airport** was opened at Novosibirsk at the end of last month, according to reports from East Berlin. A second airport, for which a big development project is planned, is being used for Tu-104 services to Novosibirsk.

● **The capital of Union Aéromaritime de Transports** is to be increased from 51,000,000 francs to 665,000,000 francs by the issue of 61,400 new shares of 10,000 francs each. The funds thus obtained will be used to expand U. A. T.'s activities.



Thomson Houston (France) has received an order from the Belgian Airways Administration for a second GCA installation for Brussels-Melsbroek Airport. The first installation (see picture) has been in operation since 1949.

INDUSTRY

● **Vickers-Armstrongs Ltd.** is in an unusually good position at a time of great uncertainty in British aviation. The winding up of the *Valiant* line and the cancellation of certain guided weapons contracts have left

The Macchi MB.326 two-seat jet trainer, fitted with lightweight Martin-Baker Mk. 4 ejection seats and powered by an Armstrong Siddeley ASV.8 *Viper* of 1,750 lbs. static thrust. The MB.326, which has been undergoing tests for some time, has a span of 32.8 ft.; wing area 204.5 sq. ft.; gross weight 5,950 lbs.; maximum speed 351 knots at sea level, 380 knots at 19,700 ft.

The Brussels Universal and International Exhibition 1958: Sabena's aircraft already carry the emblem of the exhibition – globe, star and the Brussels Town Hall.

The new Czechoslovakian L.200 *Morava* touring aircraft, powered by two 160 h.p. Walter *Minor 6-111s*. Gross weight 4,080 lbs.; cruising speed 140 knots at 6,560 ft.; range 860 nautical miles; service ceiling 18,040 ft. In its structure, equipment and performance the L.200 can be compared to the most modern U.S. aircraft of its category.

Fighter catapult launching systems are also being developed by the Russian Air Force. The periodical "Sovietskaya Aviatsia" of December 28th, 1957, shows a MiG-19 immediately after launching, with a rocket booster, apparently jettisonable after burn-out, mounted below the rear fuselage. Similar launching systems were at one time developed in the United States for the Republic F-84 *Thunderjet*.

gaps, but the broad base of civil development is likely to carry Vickers through to 1964-65, with varying ups and downs in the rate of production. The *Viscount* is entering its second major sales phase. Total orders stand at 375 with 262 aircraft delivered. The company expects that in 1958 there should be the beginning of a new flow of re-orders from old customers, and the two main prongs of new *Viscount* sales attack are being concentrated on the 810/840 series and the type 790 for U.S. local service carriers. The first *Vanguard* should fly this autumn. Production rate of *Vanguards* will be three per month by 1960. Certain regional carriers in Europe are studying the *Vanguard* as a multi-purpose aircraft for internal European running and also North Atlantic one-stop services. Both British European Airways and Trans-Canada Airlines have ordered twenty *Vanguards*.—The first VC.10, of which 35 are on order for B.O.A.C., will fly in the late summer of 1961, and first deliveries will be made in 1963. It will cruise at about 600 m.p.h. over medium stages, carry 120/150 passengers and have transatlantic capability. The VC.10 will have four Rolls-Royce *Conways* in a rear fuselage installation.

● **Nord Aviation** is the new name of the former Société Nationale de Constructions Aéronautiques du Nord (SNCA du Nord). The change was approved by the annual meeting on January 6th. According to a report presented at the meeting, sales in 1957 were in excess of 22,000,000,000 francs, compared with 19,300,000,000 francs in the previous year. The meeting adopted a proposal to increase the company's capital in two stages from 3,500,341,000 francs to 4,000,000,000 francs and eventually to 4,525,000,000 which will be divided into 5,000-franc shares instead of the present 700-franc shares.

● **Fiat** of Turin has received a contract from the U.S. Government for the overhaul and repair of an initial batch of sixty F-86 jet aircraft. The necessary equipment to carry out the work will be supplied by the U.S. Government.

● **Lockheed Aircraft Corporation**'s sales in 1957 reached an all time record of more than $900,000,000, representing a 21 percent increase over the $743,000,000 figure in 1956. The following highlights are taken from the review by Robert E. Gross, Board Chairman: Lockheed is working on nearly 100 research and development projects ranging from manned aircraft design to studies of atomic propulsion of air and space vehicles and remote guidance of unmanned space ships. Missile sales represented eight percent of last year's total. This proportion is expected to climb to 20 percent in 1958. Order backlog is at present $100,000,000. The company is entering 1958 with nine military aircraft and four commercial passenger or cargo aircraft in various stages of production. The backlog during 1958 is expected to average close to the $1,300,000,000 total at the end of 1957. The current *Electra* backlog is above $300,000,000. Sales next year will total about $750,000,000, a decline from the 1957 level that, Gross said, reflects "to a large degree" recent reductions in military spending and a lull in commercial transport sales prior to a surge in deliveries of new *Electra* turboprops starting late in the year.

The Vickers-Armstrongs VC-10 long-range jet airliner with four Rolls-Royce *Conways*, each of approx. 21,000 lbs. thrust. B.O.A.C. has placed an order for 35 aircraft, with an option on a further 20. Span 140 ft.; wing area 2,800 sq.ft.; gross weight approx. 300,000 lbs.; cruising speed 625 m.p.h. at a minimum altitude of 40,000 ft. Seating for 152 passengers in extra high density seating, up to 135 in standard high density, or 108 in a first class arrangement.

● **Lockheed missile test facilities** to be used in the Air Force's missile programme are under construction at Lockheed Missile Systems Division's 4,000-acre test site in the Santa Cruz mountains, south of San Francisco. The facility, where actual testing of the various missile components will take place, includes concrete and steel test stands, a reinforced concrete blockhouse, and two test cells. It is expected to be completed next spring.

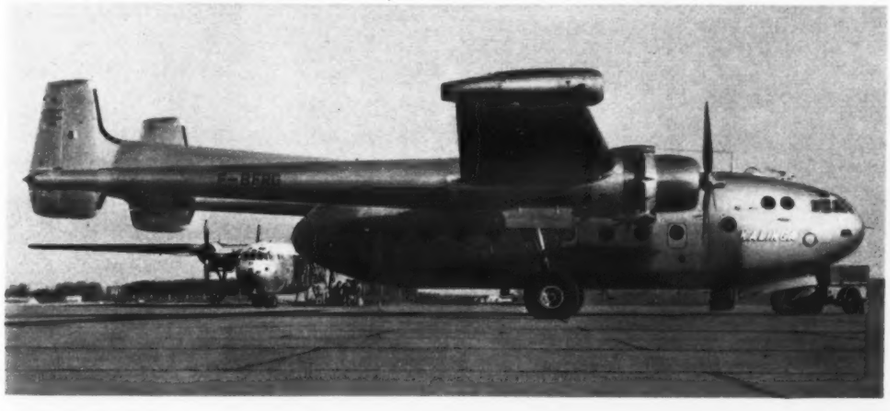
AIRCRAFT AND POWERPLANTS

● The first details of a new Czechoslovakian two-seat sports and training aircraft, the *Zlin Z.326 Trener-Master*, are available. This is apparently a development of the well-known Type Z.226; it is powered by a 160 h.p. engine (possible the *Minor 6-III*) and has a retractable conventional undercarriage. Maximum speed 132 knots; service ceiling 15,750 feet; range 350 nautical miles; take-off distance 273 yards; landing distance 230 yards.

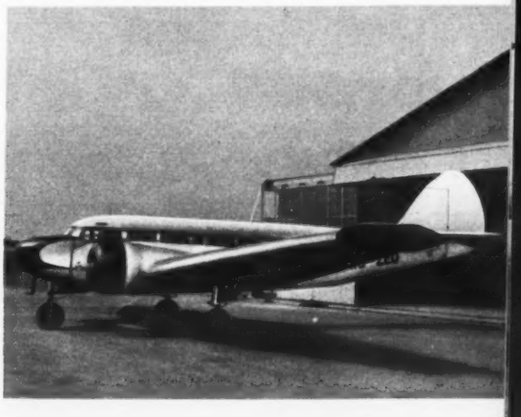
● The *Borgward-Focke Kolibri I* helicopter has been completed at Borgward's Bremen factory and will probably have made its first flight by the time these lines appear. The *Kolibri I* is equipped for three occupants and is powered by a 260 h.p. *Lycoming* engine. Production is planned.

● A high-wing monoplane with floats, the *L-21S Flying Vintra*, is at present under development by the Institute of Science and Technology in Manila. The

A Nord 2508 *Norallas*, fitted with Turboméca *Marboré* auxiliary jets, was demonstrated to Kalinga Airlines and the Indian Air Force in December 1957 and January 1958. 200 hours flying time were completed, and the aircraft returned to France in mid-January.



The Mexican-built Lascurain *Aura* feeder aircraft with twin Jacobs engines of 245 h.p. take-off power. Seating for 12 passengers and two-man crew. Cruising speed approx. 100 knots; gross weight 8,160 lbs.



Supersonic English Electric P.1B fitted with two Rolls-Royce *Avons* with afterburners. Armament: 30-mm Aden cannon and de Havilland *Firestreak* guided missiles.

aircraft is powered by a 225 h.p. Continental 0-470-B engine and is equipped for four passengers.

● *Sikorsky S-62*, powered by a single General Electric T58 gas turbine, will be ready for its first flight in the spring of 1958. A peculiarity of the S-62 is that the machine is designed for water as well as land operations, but emergency floatation gear is not required. The bottom of the fuselage is entirely watertight and strengthened to permit landings on either water or snow. For land operation, main wheels are mounted under two floats (a tail wheel is provided). In flight, the main wheels can be partially retracted. The helicopter will feature a considerable number of components identical to those of the S-55; all rotor blades, main and tail rotor heads, main, intermediate and tail gear boxes, shafting, tail rotor pylons and portions of flight control and hydraulic systems are among the S-55 components to be incorporated in the S-62.

● *Grumman Aircraft Engineering Corp.* and the Navy have jointly announced that Grumman has submitted the winning design for the Navy's recent attack aircraft competition. Designed for high and low altitude operation, this carrier-based aircraft will be turbojet-powered and will be manned by a crew of two. A new agricultural aircraft is reported to be in an advanced stage of development at Grumman Aircraft.

● Following a new series of test flights, work on the prototype *Breguet 1001 Taon* had been virtually completed by the end of 1957. A second *Taon 1001* prototype, which will incorporate a number of modifications, is nearing completion, and is expected to make its first flight in the near future.

Dr. Rudolf Heberlein, Chairman of the Board of Swissair since 1951, died of an acute heart attack in January at the age of 57. He was a great advocate of intercontinental air services and did much to win international esteem for the Swiss flag carrier. He was also a confirmed believer in increased collaboration between European airline companies, and in the last few weeks of his life gave a great deal of attention to the problem of financing jet equipment for Swissair through Swiss banking firms.

● Flight testing of the prototype *Dassault Mirage III* interceptor is continuing, and a pre-production batch of 10 aircraft is being built at the Marcel Dassault plant. It will be recalled that the prototype, powered by a SNECMA *Atar G* of 9,920 lb. thrust, has already achieved a speed of Mach 1.8 in level flight. The pre-production batch, equipped with the *Atar 9* of 13,230 lb. thrust, should certainly exceed this figure.

● The single-seat *Nord-Aviation Griffon 02* "delta canard", powered by a combination of jet and ramjet engines, is continuing flight tests at Istres where it has recently achieved speeds in the order of Mach 1.85 in a climb at 29,530 f.p.m. Superior performance will later be attained in both climb and level flight. The *Griffon* is powered by a SNECMA *Atar E.3* jet engine of 7,720 lb. thrust, and a ramjet designed and developed by Nord-Aviation.

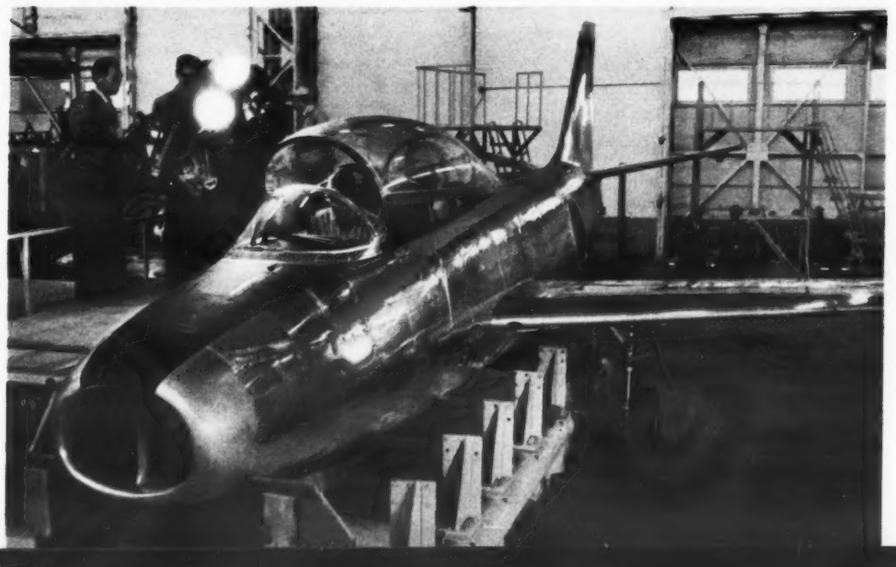
● The *I.A.45* twin-engine multi-purpose aircraft, produced by *Fábrica Militar de Aviones*, Córdoba, has commenced its flight tests.

● It has been officially confirmed that *Générale Aéronautique Marcel Dassault* is developing a four-jet 9-passenger executive transport. The *Mediterranée* will have a cruising speed of 485 knots, a range of 1,350 nautical miles, and will be of conventional swept-wing design with the engines mounted in nacelles below the wings.

● *De Havilland* has undertaken design studies and certain mock-up work on a small high-speed *executive transport* which, it is believed, will be powered by two Bristol *Orpheus*.

● Flight testing of the *Fairey Tipsy Nipper*—type 66—constructed by *Avions Fairey S.A.*, has commenced at Gosselies Airport, Belgium. This is reportedly the smallest aircraft in the world; monoplane design, with tricycle undercarriage, and powered by a Volkswagen engine.

First prototype of the Japanese Fuji TIF2 two-seat trainer fitted with a Bristol *Orpheus*. A small experimental batch of the TIF2 is planned, and also a later version powered by the Nippon Jet Engine Co. J-3 engine.

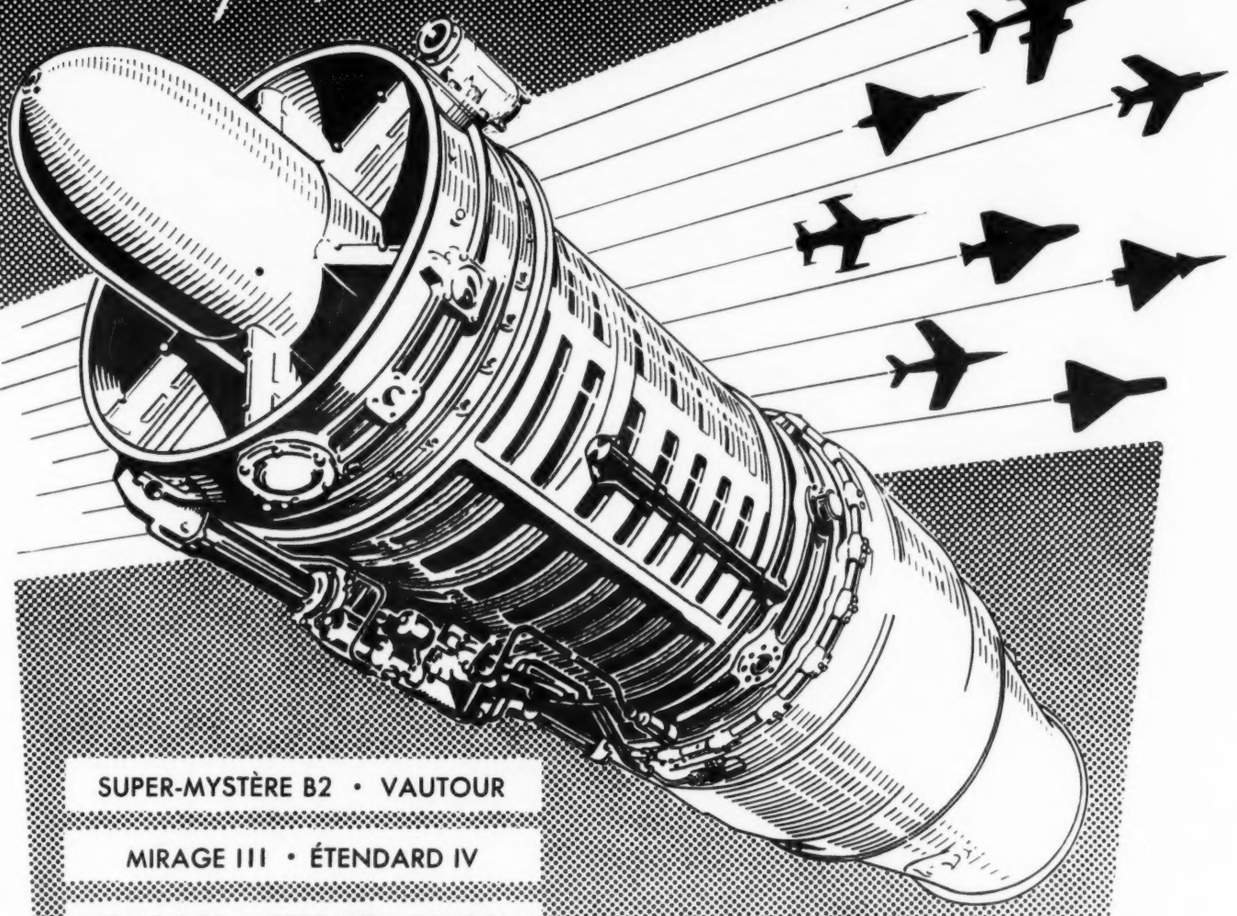


Sketch of the new Sikorsky S-62 turbine helicopter with General Electric T58. A prototype of the S-62 is scheduled for flight testing in the spring of 1958.

LES TURBO-RÉACTEURS

ATAR

équipent...



SUPER-MYSTÈRE B2 • VAUTOUR

MIRAGE III • ÉTENDARD IV

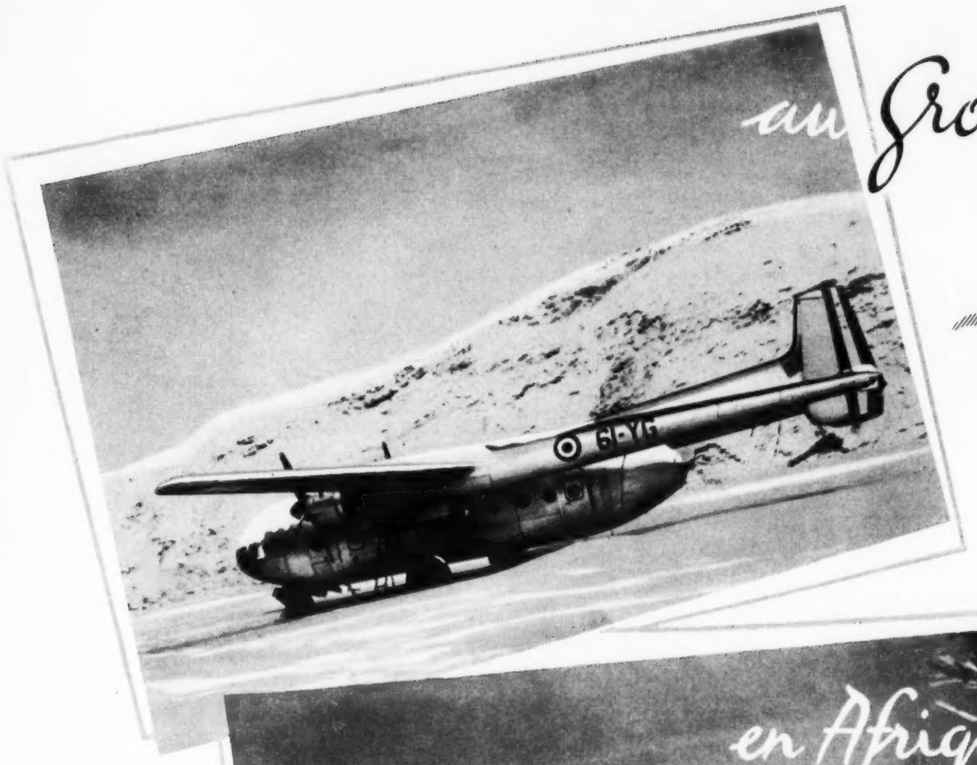
LEDUC 0-22 • GERFAUT • GRIFFON

BAROUDEUR • DURANDAL

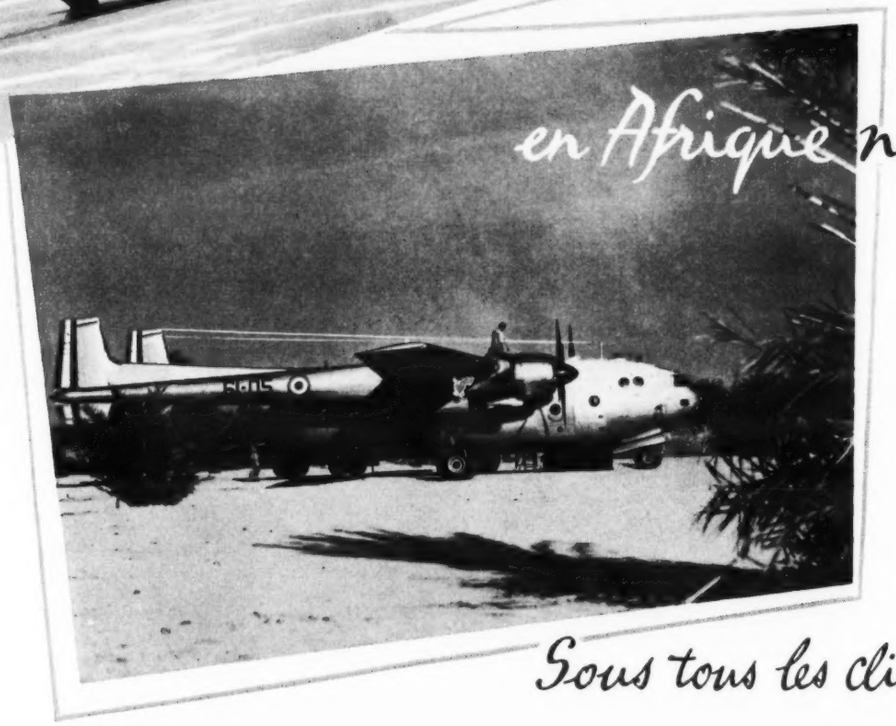
SOCIÉTÉ NATIONALE

D'ÉTUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION

150, BOULEVARD HAUSSMANN PARIS-VIII[e]



au Groenland,



en Afrique noire,

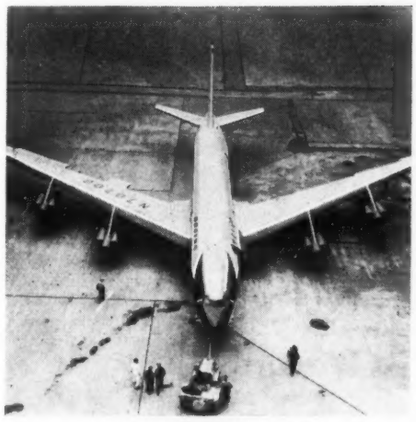
Sous tous les climats....

NORATLAS

NORD-AVIATION

2A 18, RUE BÉRANGER
CHATILLON SS BAGNEUX
(Seine) Tél. ALÉSIA 57-40

First flight—ahead of schedule



707 prototype, already test-flown 3½ years, has crossed U.S. at average speed of 612 mph.

On December 20, 1957, the No. 1 production model of the Boeing 707 jet airliner made its first flight—a week ahead of schedule.

Incorporated in this swift giant of the airlanes—and in its shorter-range sister ship, the 720—are all of the benefits of the experience Boeing gained building more than 1600 long-range multi-jet aircraft. Incorporated also are design advances made possible by more than three and a half years of intensive flight testing of the prototype model of the famous Boeing 707.

Early next year airlines will begin offering luxurious, 600-mile-an-hour service in Boeing jetliners.

When airline customers fly aboard a superb 707 or 720, they'll enjoy incredibly smooth, vibration-free travel, in an airliner built by Boeing—world's most experienced builder of long-range, multi-engine jet aircraft.

BOEING 707 *and* **720**

These airlines already have ordered models of the Boeing family of jetliners: AIR FRANCE - AIR INDIA - AMERICAN - B.O.A.C. - BRANIFF - CONTINENTAL - CUBANA - LUFTHANSA - PAN AMERICAN - QANTAS - SABENA - TWA - UNITED - VARIG

SABENA serves

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39 countries

104 cities

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58

Westland WESSEX

The Wessex is the first helicopter in the world to go into production powered by a free-turbine engine. During the first flight of the prototype earlier this year it was airborne for sixty-five minutes. Subsequently it has made a series of successful test flights of varying duration. The free-turbine engine gives the Wessex advantages of supreme economic and operational importance:

It enables the helicopter to be airborne from a cold start within 45 seconds.

It uses the same fuel as jet aircraft, thus eliminating the necessity to store two types of fuel on airfields and aircraft carriers.

It reduces the noise element inherent in piston engined helicopters to an unobtrusive purr.

It reduces vibration to the minimum, which means less wear on components, and greater comfort for passengers and crew.

The compactness and light weight of the engine allow for increased payload.

The Wessex has been ordered for the Royal Navy for anti-submarine duties.
It is powered by a single Napier Gazelle free-turbine engine.

WESTLAND

The Hallmark of British Helicopters

WESTLAND AIRCRAFT LIMITED - YEOVIL - ENGLAND

The Safeland Arrester Net

A number of air bases in Sweden, Denmark, France, Italy, Norway and Switzerland are now equipped with safety devices designed to stop jet aircraft which for one reason or another overshoot the paved runway. In peacetime these devices prevent costly accidents, and in wartime permit use of makeshift runways and partially destroyed airstrips. Normally their task is merely to arrest aircraft which, because of bad visibility or malfunctioning, threaten to overrun the end of the runway during landing or aborted take-off. In wartime they enable operations to be continued in all weathers or with overloads, and provide additional safety in cases of pilot fatigue or damage to the aircraft.

The *Safeland* arrester net is manufactured in Sweden by BEFAB (Borgs Fabriks Aktiebolag), Norrköping, under licence from the Swedish Air Force. The system was developed by the Swedish Air Board, which had been experimenting with arrester nets at one of its research and development centres since 1953, but later handed over production to BEFAG.

The system is based on the principle that the braking action should be applied as high as possible and distributed as evenly as possible. It therefore uses a wide-mesh net which catches the aircraft's wings. This method has the following advantages:

- The aircraft is arrested more safely than by any other device, irrespective of the location and height of the landing gear and of whether external loads are carried;
- As the brake load is distributed over the aircraft, little or no damage is normally caused to the aircraft;
- Because the highest possible point of attack has been selected for the braking power, there is no downward pressure on the nose-wheel and hence no danger of fracture. If the wing tips are slightly above the centre of gravity, the nose-wheel is even raised from the runway, which improves aerodynamic braking;
- In addition, the net can be used for varied types of aircraft. It provides stabilization and prevents the aircraft from tipping over. It also works in all weather conditions, requires little maintenance and after use can be rapidly prepared for re-use. Finally, it is quickly dismantled and easily transported.

A *Safeland* installation *(Figure)* consists in essentials of the following components: one net, two stanchions and two brake and anchor assemblies.

The *net* consists of two horizontal cables and a series of vertical nylon ropes and has a standard effective width of 180 ft. It is connected at both ends to steel wire wound round the brake drums. The height of the net varies between 8 ft. and 13 ft.

The two *stanchions* are designed to keep the net extended and to aid in raising and lowering it. Installed one on either side of the runway, they can be operated either manually or by electric remote control. It takes approximately 6 to 7 seconds to raise a 10-ft. net if the stanchions are flat on the ground, but only 2 to 3 seconds if the system is in the so-called preparedness position, i.e., with the net flat on the ground but the stanchions raised approximately 30°. The stanchions are so designed that an aircraft would not suffer excessive damage even if it collided with them head-on.

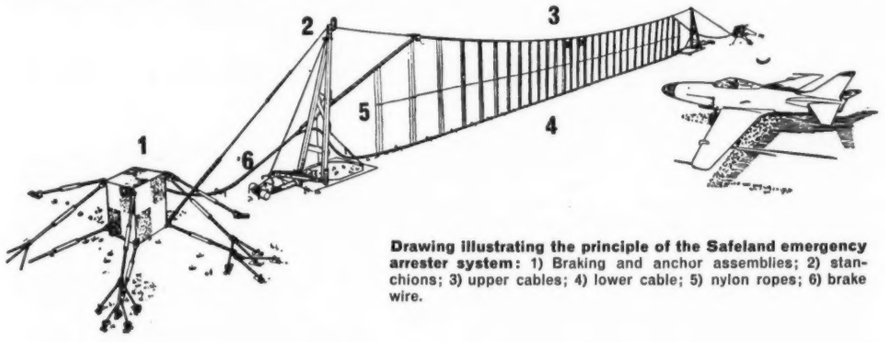
The *brake and anchor assemblies,* also one on either side of the runway, each contain a pneumatic brake and are anchored to the ground by means of stays and ground spikes, thus requiring no concrete foundation. At present two different types of brake are available, one with a braking power of 17,600 lb., used in the *Safeland 4 : 3,* and the other with a power of 26,400 lb., as used in the *Safeland 6 : 3.* Their performance can be seen from the graphs. In addition, larger nets with a braking power of up to 52,800 lb. and capable of arresting light jet bombers weighing from 35,000 to 60,000 lb. are being made. These use several pairs of brake drums.

SAFELAND SYSTEMS

Type	Aircraft weight class (lb.)	Brake power (lb)
4 : 3	8,000 to 22,000	17,600
6 : 3	17,600 to 30,800	26,400
12 : 3	30,800 to 61,600	52,800

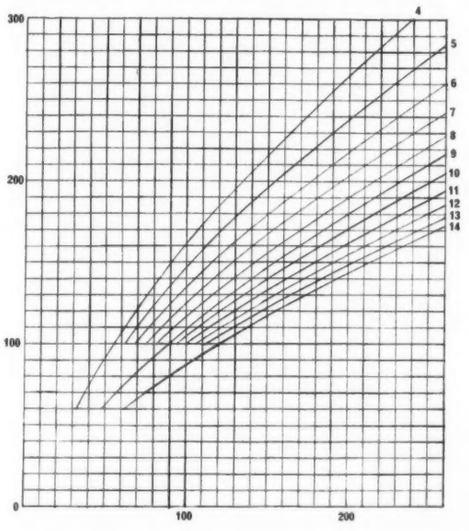
Normally, when an aircraft strikes the net, it is "enclosed" by the two horizontal cables, one engaging above the wing and the other below. The vertical nylon ropes engage the wing leading edge and distribute the load evenly over the span. When the net has been stretched to a certain degree, the shear pins disconnect the upper wire and release the net from the supports. The lower cable sets the brake drums in operation, and brake pressure gradually increases, reaching its pre-set maximum after 1 second.

If the aircraft does not strike the net head-on, but obliquely, as occasionally happens in emergencies, it is immediately stabilized *(Figure),* and ground loops are prevented. Experience has shown that the presence of an arrester system also has psychological advantages. If the pilot knows that a "rabbit

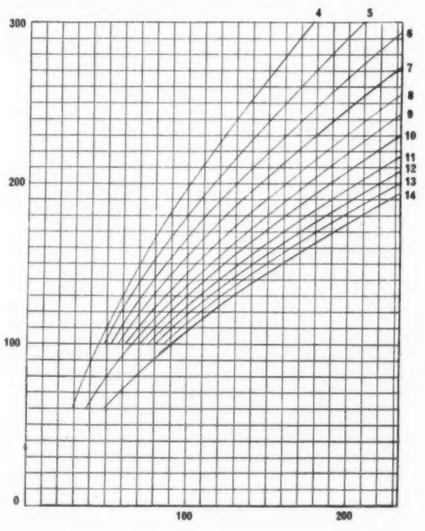


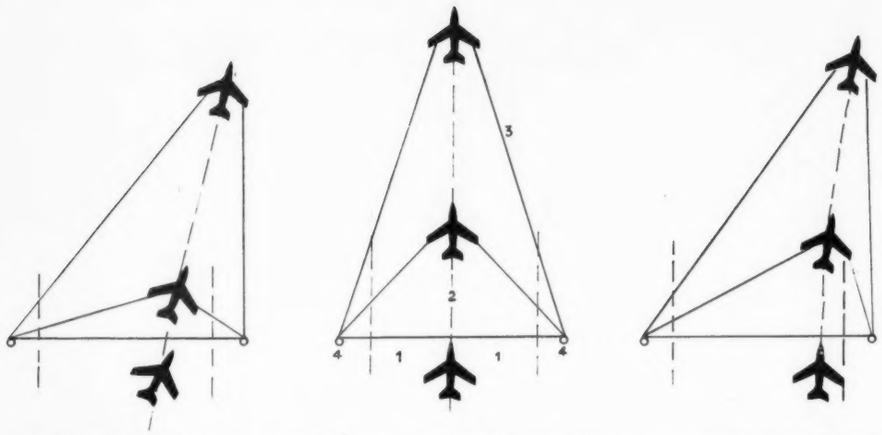
Drawing illustrating the principle of the Safeland emergency arrester system: 1) Braking and anchor assemblies; 2) stanchions; 3) upper cables; 4) lower cable; 5) nylon ropes; 6) brake wire.

Brake power of the Safeland 4:3: Braking distances in metres (abscissa) plotted against taxying speed in km/h (ordinates) and gross weight in metric tons (parameter). The 0.47-inch brake cable is 690 ft. long and connected at each side to brake drums with a brake power of 8,800 lb.



Brake power of the Safeland 6:3: Braking distances in metres (abscissa) plotted against taxying speed in km/h (ordinates) and gross weight in metric tons (parameter). The 0.55-inch brake cable is 605 ft. long and connected at each side to brake drums with a brake power of 13,200 lb.





The **Safeland** installation in normal operation *(centre)*, arresting an aircraft striking it asymmetrically *(left)* and preventing ground loops *(right)*.

catcher" is waiting for him at the end of the runway, he has a greater feeling of confidence and will keep his head in an emergency.

No specially trained personnel is required to install the *Safeland*. Parts are supplied as complete kits and are erected directly on the field, without any preliminary work. After use the net can be restored to operating condition in about 10 to 15 minutes ; all that is needed is to rewind the braking wire on to the brake drums by means of a semi-automatic electric device. Even should one of the nylon ropes be damaged, as happens occasionally, the net as a whole retains its properties and can continue to be used until such time as it can be repaired without interrupting flying activity.

The first *Safeland* system was installed by the Swedish Air Force in 1953 and is still being used at one of the night fighter bases. During the past four years it has prevented many serious accidents and saved the Swedish Government a mint of money. In the meantime, however, considerable modifications and improvements have been made. *Safeland* installations have also been tested in other countries under widely varying conditions and with many different aircraft types, which has led to still further improvements. In some cases, for example, jet aircraft weighing up to 20,000 lb. have been arrested at almost full take-off speed after an aborted take-off. Thus the experimental stage has long been passed, and *Safeland* installations are today fully proven and operational.

Up to date, *Safeland* nets have been used with the following aircraft types, either for tests (T) or in emergencies (E) :

Aircraft type	Test	Emergency	Country
SAAB J29	T	E	Sweden
de Havilland **Vampire**	T	E	Sweden, Switzerland
de Havilland **Venom**		E	Sweden
Republic F-84G **Thunderjet**	T	E	Norway
Republic F-84F **Thunderstreak**	T	E	Denmark
North American F-86 **Sabre**	T		Italy
Dassault **Mystère IV**	T		France
SAAB A 32 **Lansen**		E	Sweden
Hawker **Hunter**		E	Sweden

The manufacturers state that the price of the installation is low. Operating costs are also moderate, as only little maintenance is required. Every installation can be quickly dismantled, packed and re-erected at another air base. The type 6 : 3, for example, weighs only about 6,600 lb. and occupies a volume of approximately 280 cu. ft. The nets can therefore be transported by air.

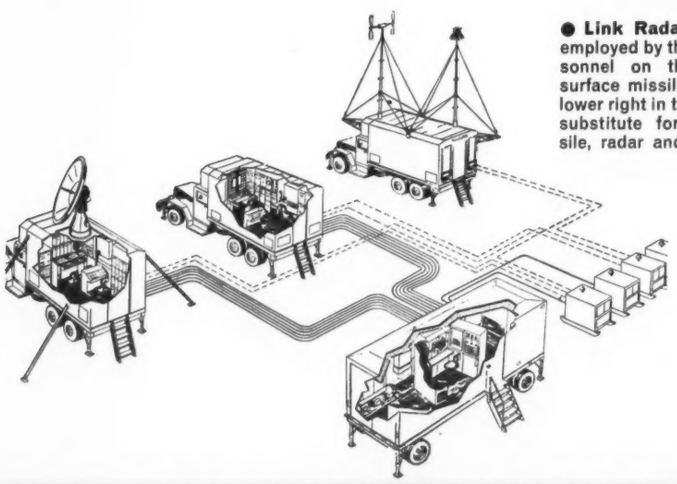
*

At present large installations are being designed for use with commercial jet transports weighing up to 300,000 lb. Such nets will contribute substantially towards improving safety and enabling commercial aircraft to operate in all weathers.

Telecommunications and Electronics

● **Elliott Brothers (London) Limited** has produced the type B. 585 EASI (Elliott Automatic Standing Wave Indicator) to facilitate the rapid and accurate measurement of the performance of microwave components and systems in the 3.2-cm band. The equipment is based on a rotary standingwave indicator in which a circular section waveguide is coupled by a hole or slots to the broad face of a rectangular waveguide (RG.52/4). Forward and reflected waves in the rectangular guide induce simultaneously in the circular guide two circularly-polarized waves of dependent magnitudes and directions of rotation. These waves combine to produce an elliptical polarization whose axial ratio is the standingwave ratio in the rectangular guide. Ellipticity is measured by passing the wave through a Ferrite rotator whose applied magnetic field causes the axes of the elliptically-polarized wave to oscillate by ±90° about the mean position. Through a mode suppressor the wave is plane-polarized and amplitude modulated, the maximum and minimum being equal major and minor axes of the ellipse and hence to the standingwave measured.

● **Aircraft Radio Corporation,** Boonton New Jersey, now has in production a new VHF communications system weighing only 22 lbs. Known as the ARC Model 210, the unit works on 360 channels in the 118 to 135.95 Mc/s frequency range and is suitable for both military and commercial aircraft. The Model 210 may be used either as a single-channel simplex or double-channel simplex with 6 Mc/s separation. Channel spacing 50 kc/s; transmitting power 15 Watts with very low spurious output; receiver sensitivity 2 microvolts.



● **Link Radar Signal Simulators** are being employed by the U.S. Air Force for training personnel on the Martin Matador surface-to-surface missile. The Link Simulator, shown at lower right in the picture, serves as an electronic substitute for the Matador, permitting missile, radar and guidance crews housed in the two vans on the left of the picture, to track and guide the simulated missile with the same equipment used to control the live Matador.

Link also has a systems training equipment for use with the " self-guided " missiles which simulates the launching of these weapons and automatically records all control data.

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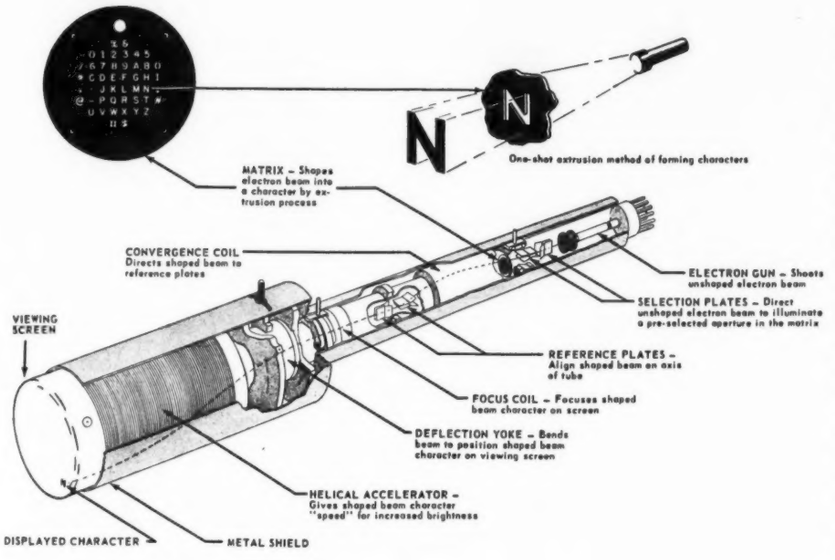
INTERAVIA
REVIEW OF WORLD AVIATION

● **An airborne closed-circuit TV monitor** for observation of power units, control surfaces and landing gear etc. has been developed by General Precision Laboratory Inc., Pleasantville, N.Y. Here, for example, the camera unit has been mounted beneath the nose of a DC-3 flying testbed for observation of the undercarriage during take-off and landing.


One-shot extrusion method of forming characters
MATRIX – Shapes electron beam into a character by extrusion process
CONVERGENCE COIL Directs shaped beam to reference plates
ELECTRON GUN – Shoots unshaped electron beam
SELECTION PLATES – Direct unshaped electron beam to illuminate a pre-selected aperture in the matrix
VIEWING SCREEN
REFERENCE PLATES – Align shaped beam on axis of tube
FOCUS COIL – Focuses shaped beam character on screen
DEFLECTION YOKE – Bends beam to position shaped beam character on viewing screen
HELICAL ACCELERATOR – Gives shaped beam character "speed" for increased brightness
DISPLAYED CHARACTER
METAL SHIELD

● **The Stromberg-Carlson Company, San Diego, and The Haloid Company, New York,** have developed a high-speed electronic printer which permits the output of electronic computers to be printed at the rate of 4,680 lines per minute. Designated S-C 5000, the equipment essentially comprises a Stromberg-Carlson " Charactron " shaped beam tube (see illustration) and an " Xerox Copyflo " printer manufactured by The Haloid Company; the S-C 5000 may be used in both the on-line method of receiving electronic data direct from the computer and the off-line method from magnetic tape. Electrical impulses from the computer are translated into a display of numbers, letters and symbols by means of the " Charactron " tube (diameter of screen 7 inches) in which an electron gun shoots its beam through tiny shaped openings which form the beam into characters. These characters are projected by an optical system into the xerographic process, sensitizing the surface of a selenium drum; the latent images thus produced are developed with dry powder electrostatically and then printed on continuous rolls of paper.

The " Charactron " tube employed in the S-C 5000 reproduces 64 characters, i.e. the letters of the alphabet, ten numbers and 28 symbols of the user's choice. The smooth and quiet operation of the S-C 5000 permits its use in modern office areas. Both the " Charactron " tube and the " Xerox Copyflo " printer are comparatively new developments, and the combination into a fast print-out device is of importance in the field of data processing.

● **An automatic antenna selector** is now being manufactured by the Autonetics Division of North American Aviation Inc. Occupying a space of less than 120 cu. ins., and with a weight of 2 ½ lbs., the transistorized device solves the problem of inadequate or unreliable in-flight reception of communications signals. The selector automatically monitors incoming signals and selects exposed antenna for the most dependable reception.

— Power consumption 70 mW at 28 volts DC;
— Shock resistance up to 30-g impact;
— Operational altitude 70,000 ft.

The instrument may also be used in conjunction with the TACAN navigation system.

● **Hughes Aircraft Company** has for the last six months been producing the " Digitair " airborne digital computer which is pictured here fitted in the nose of a Convair F-102A supersonic fighter. Developed especially for use in interceptors, the small " Digitair " equipment can make 9,600 basic arithmetical computations per second and render 6,250 decisions per minute, simultaneously taking in 61 different types of information from ground control stations and the aircraft's own radar, and putting out 30 types of information. These include instructions to actuate the control surfaces to correct pitch and roll, instructions to the pilot to increase or decrease speed, maintaining constant checks on available fuel and remaining range, target range, azimuth and elevation information, correct speed and altitude required in order to intercept the target—in practice, virtually all the information required for aircraft control, navigation, target detection and attack. The computer performs, or monitors, sixteen separate navigation and flight control functions at least once during a programme cycle of 1.8 seconds. The " Digitair " weighs only 120 lbs.

Book Reviews

Gas Turbine Materials. By G. Lucas and J. F. Pollock. — Temple Press Limited, London (published in association with " The Oil Engine and Gas Turbine "), 1957 (English, 163 pages, price 25 shillings).

Progress in gas turbine development is attributable not only to advances in aerodynamics and thermodynamics, but is just as often due to new metallurgical knowledge. This book by two engineers who have been closely connected with gas turbine development for many years, is thus highly welcome. It covers not only the qualities of the alloys used, but also contains details of their applications and machining properties, As would be expected, chief attention is given to gas turbines for aeronautical use, whose efficiency at the present stage of technical development can be improved only through improvements to heat-resistant alloys. The book can therefore also be recommended to aeronautical engineers not normally concerned with metallurgical problems.

Re.

Entwicklungsstand 1957 der unbemannten Flugkörper, Überschall-Fluggeräte und Raumfahrzeuge (Report No. 12 of the Forschungsinstitut für Physik der Strahlantriebe). — By Dr. Eugen Sänger. — R. Oldenbourg, Munich, 1957 (German, 143 pages, price DM 44).

A tabulated list of data on some 250 types of supersonic vehicles and space ships, compiled in pre-*Sputnik* days. From manned supersonic fighters (group 1), via guided and ballistic missiles (groups 2 to 6), to moon vehicles Nos. 1 and 2 (group 12) and manned space vehicles (group 16; none yet in existence), the author lists designations, main dimensions, estimated performance of the various types, in random sequence, sometimes using arbitrary symbols and terminology and always —unfortunately—without indication of source. Details of sources would be particularly welcome, since in his foreword the author specifically states that he must leave the responsibility for the accuracy of his data to the " international trade press ". The book also includes some 40 pages of philosophical, political, military and economic speculations about the future, plus a diagram predicting a " manned high-speed aircraft " to fly at the speed of light (sic) by 2000 A.D.

Ri.

Mikrowellenröhren ; Einführung in die UHF-Elektronik.— By W. F. Kowalenko. Verlag Technik, Berlin, and Porta Verlag, Munich, 1957 (German, 370 pages with 100 pictures and 40 plates; price DM 33).

In this book the author sets out the experience which he gained during his years of work in the Soviet Union on the development of microwave tubes. He writes not only for the specialist, but also for all development engineers, technicians and students with basic knowledge of electrical engineering. In view of the wide applications of microwave tubes in science and industry, e.g., in microwave radio links, radar equipment, etc., the present book should interest a wide circle of readers.

Na.

Mitteilungen der Akademischen Fliegergruppe Graz — Volume 1. — Obtainable from Akaflieg Graz, Institute of Technology, Graz, 1957 (German, 112 pages).

Full marks to the enterprising spirit of a small gliding club—certainly not a wealthy one—for producing a book designed to increase its members' technical knowledge and to arouse interest in sports flying. Contents include contributions by F. Brandner (on general aviation questions), E. Walzel (on calculating wing shells) and L. Siencnik (on measuring the polars of the Musger Mg 19b).

Ri.

Boys' Book of Flight. — By David le Roy in association with the staff of " Flight ". Published by Iliffe & Sons Ltd., London, 1957 (English; 160 pages; widely illustrated; 12s. 6d.).

As Peter Twiss points out in his foreword, the volume not only presents the more sensational developments and advances, but is full of factual and interesting information. Covering the whole field of aviation in simple, concise and easily-readable language with excellent illustrations, this work is aimed at the younger member of the family, but he will probably have to wait until father has read it first.

Ru.

Dein Wunsch war immer — fliegen ! Published by Manutiuspresse, Vienna, Munich, 1958 (German, 95 pages).

Literary variations on the subject of human flight . . . from the prophet Isaiah and ancient Rome's Virgil to Saint-Exupéry and Stefan Zweig. Compiled with taste and skill. Entertaining reading.

He.

Das drahtlose Jahrhundert. — By Hans Frahm. Suddeutscher Verlag, Munich, 1957 (German, 357 pages; 53 photos; price DM 16.80).

Whereas the first launchings of artificial earth satellites are still fresh in everyone's mind, the present generation already takes radio, television, talking films, radar equipment, etc. for granted. Yet all these achievements were utopian dreams for our grandfathers. How these dreams became reality and how they have helped shape our " wireless century " is here clearly set out for the reader. The author describes the whole development, from the primitive detector to the modern electronic brain, and gives an impressive insight into the multiple applications of electromagnetic waves, in radio and television, in shipping and air navigation, in the exploitation of natural resources, in weather forecasting, in medicine, etc.

Na.

Hacia un derecho astronáutico. — By Alvaro Bauza Araujo, Head of the Legal Section, Directorate General of Communications, Uruguay. Published by the author. Montevideo 1957 (Spanish, 223 pages).

An expert on air law, the author has here produced a book of particularly topical interest. The frontiers of air law have already been crossed, a new field is opening, and the author attempts to define its general principles, before going on to detailed questions such as the legal position of interplanetary space, the special conditions applying to artificial satellites, interplanetary vehicles and relay stations, astronauts, and the legal problems which will be raised by relations with other worlds. This book, which will certainly be carefully studied and which will doubtless give rise to heated arguments in view of the nature and topicality of the subject it covers, provides an interesting contribution to one of the most important legal problems of modern times.

So.

Aérovision, Paris-Londres-Paris. — Editions Aérovision, Paris, 1957 (French maps; price 480 French francs).

This is the first of a series of route guides for airline passengers, which Aérovision plans to publish for all the routes operated by I.A.T.A. member airlines. Each route will be described according to the same pattern designed to provide the traveller with special maps corresponding to his field of view from the cabin windows (left or right), an historical and geographical survey of the regions flown over, plans of the terminal cities and brief details of the formalities to be expected. An enterprising plan, which should greatly add to the interest of air travel.

So.

Der neue Start. — Die deutsche Luftwaffe im Bild. — Edited by Harald Wust; foreword by Lieutenant General Josef Kammhuber, Inspector of the German Air Force. — Athenäum Verlag, Bonn, 1957 (German, 91 pages).

Like all the West's air forces, the young German Air Force also has its recruiting problems. To ensure that the right man is put in the right place, the young generation of pilots, navigators and mechanics must be presented with a readily understandable picture of the organizational structure and the aims of the new Luftwaffe. This task is performed in exemplary fashion in the present well-illustrated, concisely written little book.

He.

Brassey's Annual, The Armed Forces Year Book, 1957. — Sixty-eighth Edition—Edited by Rear-Admiral H. G. Thursfield. Published by William Clowes & Sons, Ltd., London, and the MacMillan Co., New York. (English, 440 pages; 30 illustrations.)

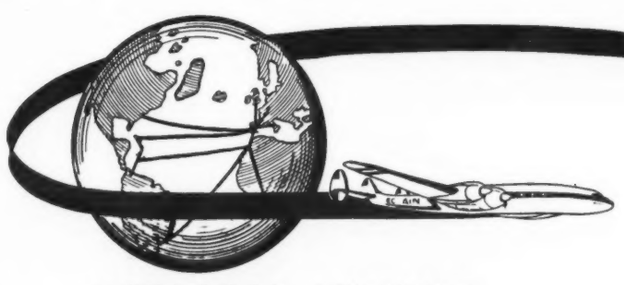
The 1957 edition again presents the layman with an authoritative review of current British thinking on varied aspects of the contemporary military scene. Although the preface claims that the bulk of the volume consists of discussion of the strength, weaknesses and probable future of N.A.T.O., there are a total of thirty chapters covering such subjects as *Defence in the Nuclear Age*, *The Evolution of Strategic Bombing*, *The Communist Air Forces*, *Guided Missiles*, *The Federal German Armed Forces*, and *Aircraft Development*. Once again interesting reading and providing food for thought.

Ru.

Vom Himmel zur Hölle. — By Will Berthold. — Suddeutscher Verlag, Munich, 1957 (German, 259 pages, price DM 12.80).

The story of German parachutists in Crete and Sicily, in the fighting around Monte Cassino and during the days leading up to the capitulation of Brest. One of the countless post-war books designed as a protest against the senselessness of war. One striking feature is the objectivity with which the author records successes and failures on both sides. Grippingly written and illustrated with war correspondents' photographs, the book will doubtless interest a wide circle of readers.

Ha.



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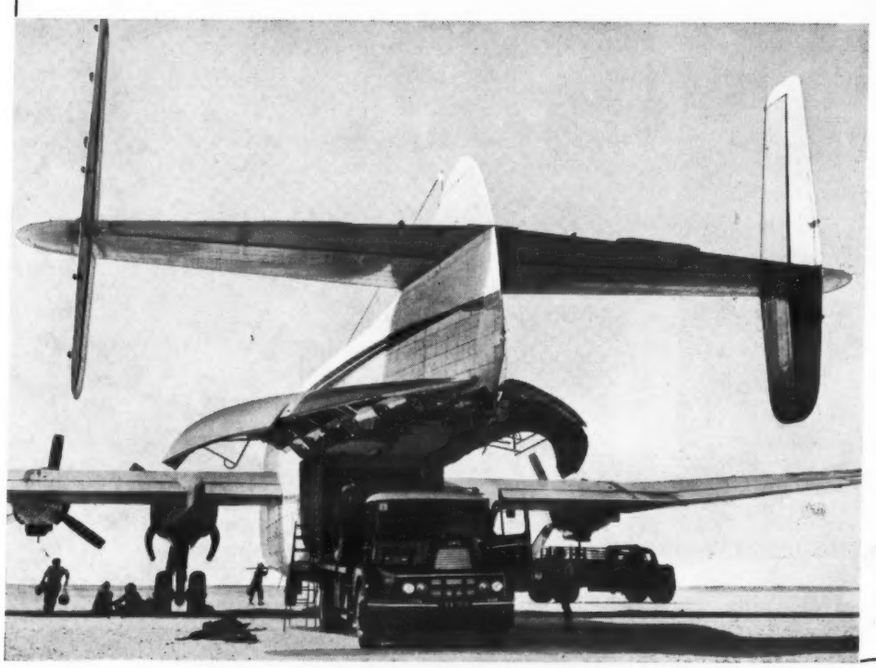

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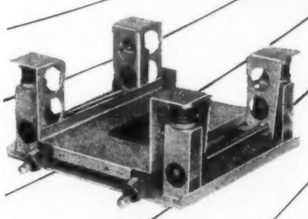

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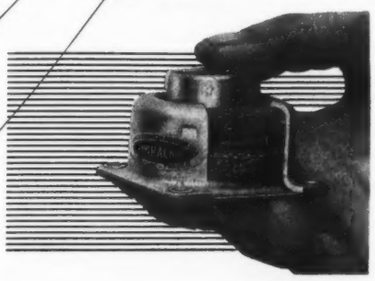

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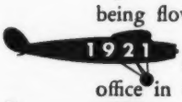
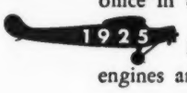
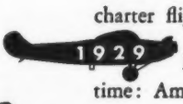


KLM opens the *first* air traffic booking office in the world.

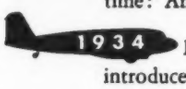


KLM is the *first* to make use of air-cooled engines and all-metal propellers.

1927 - KLM makes the world's *first* intercontinental charter flights.

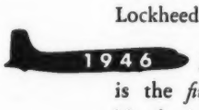


KLM opens the *longest* air route of that time: Amsterdam-Jacarta.



KLM, as the *first* airline outside the U.S.A., introduces all-metal Douglas DC-2 and wins the London-Melbourne Air Race. Two years later KLM is the first European company to buy the DC-3.

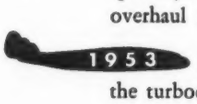
1943 - KLM, as first non-U.S.A. carrier, orders the Lockheed Constellation.



KLM, though heavily shattered by the war, is the *first* European airline to open a post-war North Atlantic service.

1948 - KLM is the first European airline to buy the Convair Liner.

1950 - KLM is the first European airline to be specially authorized by the U.S. Government to overhaul aircraft of U.S. air companies.



KLM is the world's first airline to operate the turbocompounded Lockheed Super Constellation.

1956 - KLM is the *first* carrier outside the U.S.A. to order the jet-engined Douglas DC-8 and the turboprop Lockheed Electra.

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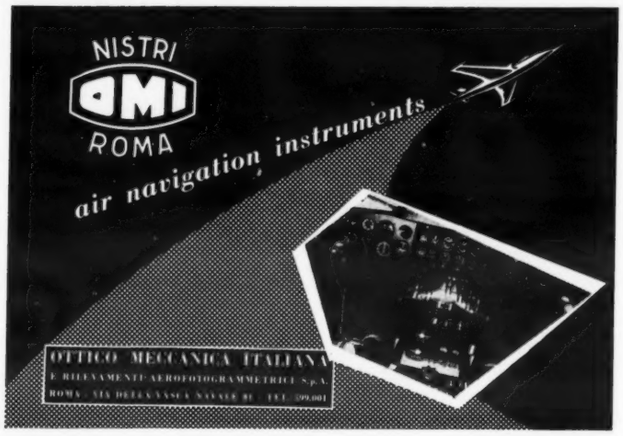

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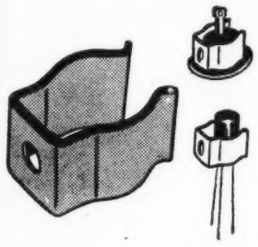

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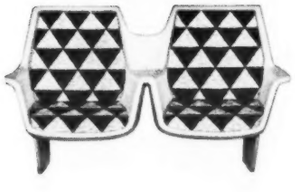

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